

ELVISS Software Prototype User Manual

April 20, 2001



Technical Report

Contract No. W7711-007674/001/TOR

Contractor Document No. 42-011-003

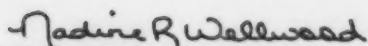
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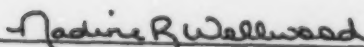
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Abstract

The HFE Group has performed development for, and modifications to, a software prototype of the Enhanced Low-Light Level Visible and Infrared Surveillance System (ELVISS) user interface. The intent of this work was to enhance the capability of the ELVISS software to allow the empirical investigation of different interface and sensor characteristics on search and detection capability under different simulated environmental conditions.

The execution of this work required the use of several software tools on Silicon Graphics, Inc. (SGI) and personal computer (PC) platforms. The prototype was developed using Virtual Prototypes, Inc. (VPI) VAPS software and SGI OpenGL Performer software. In addition to the modification of the prototype, a scenario generation interface was developed using SGI OpenGL Performer software and the public domain Fast Light Tool Kit (FLTK).

Résumé

The HFE Group a exécuté le développement pour, et les modifications à, un prototype de logiciel de l'interface utilisateur pour la système aéroporté d'imagerie multi-capteurs (ELVISS). L'intention de ce travail était de mettre en valeur la capacité du logiciel ELVISS pour permettre la recherche empirique sur différentes caractéristiques d'interface et de capteur sur la capacité de recherche et de détection dans différentes conditions environnementales simulées.

L'exécution de ce travail a exigé l'utilisation de plusieurs outils de logiciel sur Silicon Graphics, Inc. (SGI) et plateformes d'ordinateur individuel (PC). Le prototype a été développée en utilisant la logiciel de Virtual Prototypes, Inc. (VPI) VAPS et logiciel SGI OpenGL Performer. En plus de la modification du prototype, une interface de génération de scénario a été développée en utilisant le logiciel SGI OpenGL Performer et le le logiciel Fast Light Tool Kit (FLTK).

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Executive summary

This document provides instructions for the installation and use of software developed to support empirical investigation of a simulated user interface for an Enhanced Low-Light Level Visible and Infrared Surveillance System (ELVISS).

The ELVISS is an electro-optical imaging system being developed by the Defence Research Establishment Valcartier (DREV) to enhance the capability of search and rescue (SAR) crews to operate effectively at night and in degraded weather conditions. ELVISS is a dual sensor system comprising an active-gated TV (AGTV) and a Forward Looking Infrared (FLIR) imaging system. By coordinating the use of a pulsed laser illuminator and AGTV camera, the AGTV component of ELVISS provides effective imaging in the absence of ambient light. In addition, the active range gate allows the AGTV system to penetrate meteorological phenomena such as fog, snow and rain much more effectively than a FLIR camera. The FLIR camera is a passive thermal imaging system that produces an image based on temperature variation by detecting mid-infrared and far-infrared radiation. Both sensors are boresighted and are packaged in a gimballed "ball" that is mounted on the exterior of an aircraft or vehicle.

In order to ensure that a SAR operator would be able to use the system effectively and with a minimal amount of training, a prototype human-machine interface (HMI) was developed to evaluate design concepts. Two key software packages were utilized to develop the prototype: Virtual Prototypes, Inc.'s (VPI) Virtual Applications Prototyping System (VAPS) and Silicon Graphics, Inc.'s (SGI) IRIS Performer. VAPS was utilized to prototype the 2D elements of the HMI while Performer was used to render a 3D visualization of the virtual mission world in order to simulate dynamic AGTV and FLIR sensor imagery. Performer was also used to generate a moving map display for the HMI.

The ELVISS HMI prototype represents a potentially cost effective way of evaluating operator performance with respect to a candidate user interface. The existing prototype, however, had only a limited capability to record objective data and does not provide sufficient capability to develop experimental scenarios or to manipulate sensor and interface characteristics.

The HFE Group was contracted to enhance the capability of the ELVISS software prototype to allow the empirical investigation of different interface and sensor characteristics on search and detection capability under different environmental conditions.

Gamble, Murray G. 2001. ELVISS Software Prototype - User Manual. CR 2001-030, The HFE Group.

Sommaire

Ce document fournit des instructions pour l'installation et l'usage du logiciel développés pour supporter la recherche empirique sur une interface utilisateur simulée pour la système aéroporté d'imagerie multi-capteurs (ELVISS).

L'ELVISS est un système électro-optique de formation image développé par la Centre de Recherche de Defence Valcartier (CRDV) pour mettre en valeur la capacité de la recherche et pour sauver les équipages (SAR) pour fonctionner pertinemment la nuit et en conditions atmosphériques dégradées. ELVISS est un système dual de capteur comportant une TV actif-déclenchée (AGTV) et un système regardant vers l'avant de formation image d'InfraRed (FLIR). En coordonnant l'utilisation d'un bloc d'éclairage pulsé de laser et de l'appareil-photo d'AGTV, le composant d'AGTV d'ELVISS fournit la formation image pertinente en l'absence de la lumière ambiante. En outre, la porte active d'intervalle permet au système d'AGTV de pénétrer des phénomènes météorologiques tels que le brouillard, neige et de pleuvoir beaucoup plus pertinemment qu'un appareil-photo de FLIR. L'appareil-photo de FLIR est un système thermique passif de formation image qui produit une image basée sur la variation de la température en détectant le rayonnement mi-infrarouge et lointain. Les deux capteurs sont boresighted et sont empaquetés dans balle de capteurs cela est monté sur l'extérieur d'un avion ou d'un véhicule.

Afin de s'assurer qu'un opérateur de SAR pourrait utiliser le système pertinemment et avec une quantité minimale de formation, une interface homme-machine de prototype (IHM) a été développée pour évaluer des concepts de construction. Deux progiciels principaux ont été utilisés pour développer le prototype: de Virtual Prototypes, Inc. (VPI) VAPS et SGI OpenGL Performer. VAPS a été utilisé au prototype les 2D éléments du IHM tandis que Performer était utilisé pour rendre une visualisation 3d du monde virtuel de mission afin de langage figuré simuler capteur dynamique d'AGTV et de FLIR. L'interprète a été également utilisé pour produire d'un affichage mobile de carte pour le IHM.

Le prototype d'ELVISS IHM représente une voie potentiellement rentable d'évaluer l'exécution d'opérateur en ce qui concerne une interface utilisateur de candidat. Le prototype existant, cependant, a eu seulement une capacité limitée pour enregistrer des données objectives et ne fournit pas la capacité suffisante pour développer les scénarios expérimentaux ou pour manipuler des caractéristiques de capteur et d'interface.

The HFE Group a été contracté pour mettre en valeur la capacité du prototype de logiciel d'ELVISS pour permettre la recherche empirique sur différentes caractéristiques d'interface et de capteur sur la capacité de recherche et de détection dans différentes conditions environnementales.

Gamble, Murray G. 2001. ELVISS Software Prototype - User Manual. CR 2001-030, The HFE Group.

Table of contents

Abstract.....	i
Executive summary.....	iii
Sommaire.....	iv
Table of contents.....	v
List of figures.....	ix
1. Introduction.....	1
1.1 General.....	1
1.2 Background.....	1
1.3 Aim.....	2
1.4 Objectives.....	2
1.5 Scope.....	2
1.6 Report Outline.....	2
2. Installation.....	3
2.1 General.....	3
2.2 Before You Begin.....	3
2.3 Installing the ELVISS Prototype Software.....	3
2.4 Environment Variables.....	4
2.5 ELVISS Software Directory Structure.....	4
2.6 Installing the Acrobat Reader Software.....	6
3. The Scenario Development Process.....	7
3.1 The Scenario Generation Environment.....	7
3.2 The Human Machine Interface Prototype.....	8
4. The ELVISS Scenario Generation Environment.....	9
4.1 Introduction.....	9
4.2 Starting and Exiting the SGE.....	9
4.3 A quick look at the SGE.....	9

4.4	The SGE Interface	10
4.5	Using the ELVISS SGE.....	10
4.5.1	Defining a Scenario Landscape (Terrain).....	10
4.5.2	Using the Moving Map Display.....	11
4.5.2.1	The MMD Toolbar	11
4.5.3	Manipulating Targets.....	12
4.5.3.1	Adding a Target.....	13
4.5.3.2	Deleting a Target	14
4.5.3.3	Modifying Target Parameters.....	14
4.5.3.4	Previewing Target Placement and Appearance	15
4.5.3.5	Saving the Target List	17
4.5.3.6	Loading an Existing Target List.....	17
4.5.4	Manipulating the Aircraft Flight Path.....	18
4.5.4.1	User Defined Flight Path	18
4.5.4.2	Adding a Waypoint.....	18
4.5.4.3	Deleting a Waypoint.....	19
4.5.4.4	Modifying Waypoint Parameters.....	19
4.5.4.5	Creeping Line Ahead Flight Pattern.....	20
4.5.4.6	Creating a Creeping Line Ahead Flight Pattern	20
4.5.4.7	Modifying the Creeping Line Ahead Flight Pattern.....	21
4.5.4.8	Expanding Square Flight Pattern.....	22
4.5.4.9	Creating an Expanding Square Flight Pattern	23
4.5.4.10	Modifying the Expanding Square Flight Pattern.....	23
4.5.4.11	Saving a Flight Plan.....	25
4.5.4.12	Loading an Existing Flight Plan	25
4.5.5	Manipulating Sensors	25
4.5.5.1	Saving the Sensor Configuration.....	28
4.5.5.2	Loading an Existing Sensor Configuration	29
4.5.6	Manipulating the Environment	29
4.5.6.1	Description of the « Fog » Weather Effect.....	31
4.5.6.2	Saving the Environment Configuration.....	31
4.5.6.3	Loading an Existing Environment Configuration	31
4.5.7	Manipulating Additional Scenario Settings.....	32

4.5.8	Altitude Profile Display	33
4.5.9	The Scenario Summary Area	34
4.5.10	Managing Your Projects	34
4.5.10.1	Saving Your Project	34
4.5.10.2	Loading an Existing Project	35
4.6	Previewing a Specific Target Object	35
5.	Using the ELVISS Human Machine Interface Prototype	36
5.1	Introduction	36
5.2	Starting and Exiting the ELVISS HMI Prototype	36
5.3	Using the ELVISS HMI Prototype in an Experiment	37
5.3.1	Tuning the Experiment	37
5.3.2	Adjusting Runtime Retro-Reflective Behaviour	38
6.	File Specifications	39
6.1	General	39
6.2	Scenario Definition Files	39
6.2.1	Target Definition File	39
6.2.2	Flight Plan Definition File	42
6.2.3	Configuration File	43
6.2.4	Project Definition File	46
6.2.5	Target Mapping File	47
6.3	Data Collection Files	47
6.3.1	File Naming Convention	48
6.3.2	The Control Data File	49
6.3.3	The Mark Data File	49
6.3.4	The Stream Data File	49
6.3.5	The Result Data File	51
	Annex A – Target Object Types	52
	Annex B – HMI Event List	54
	Annex C – ELVISS Environment Variables	58
	Bibliography	59

List of symbols/abbreviations/acronyms/initialisms.....	60
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List of figures

Figure 1. ELVISS Software Directory Structure	5
Figure 2. Scenario Development Process	7
Figure 3. SGE Interface	10
Figure 4. MMD Toolbar Functions.....	12
Figure 5. Target Manipulation Interface.....	13
Figure 6. Target Preview Utility (Automatic Mode)	16
Figure 7. Target Preview Utility (Manual Mode).....	17
Figure 8. User Defined Flight Path Manipulation Interface	18
Figure 9. Creeping Line Ahead Search Pattern.....	20
Figure 10. Creeping Line Ahead Flight Pattern Manipulation Interface	21
Figure 11. Creeping Line Ahead Parameters	22
Figure 12. Expanding Square Search Pattern.....	23
Figure 13. Expanding Square Flight Pattern Manipulation Interface	24
Figure 14. Expanding Square Parameters	25
Figure 15. Sensor Manipulation Interface.....	26
Figure 16. Environment Manipulation Interface.....	30
Figure 17. Miscellaneous Settings Manipulation Interface.....	32
Figure 18. Altitude Profile Display	34

List of tables

Table 1. Target Parameters	14
Table 2. User Defined Waypoint Parameters.....	19

Table 3. Creeping Line Ahead Parameters	21
Table 4. Expanding Square Parameters	24
Table 5. Sensor Parameters.....	26
Table 6. Environment Parameters.....	30
Table 7. Miscellaneous Parameters.....	32
Table 8. Target Definition File Specification	39
Table 9. Flight Plan Definition File Specification	42
Table 10. Configuration File Specification.....	43
Table 11. Project Definition File Specification	46
Table 12. Control Data File Contents	49
Table 13. Mark Data File Contents.....	49
Table 14. Stream Data File Contents	50
Table 15. Result Data File Contents	51
Table 16. Target Object Types.....	52
Table 17. HMI Event List	54
Table 18. ELVISS Environment Variables.....	58

1. Introduction

1.1 General

The Department of National Defence (DND) is developing a flyable prototype of an Enhanced Low-Light-Level Visible and Infrared Surveillance System (ELVISS). The HFE Group has been contracted to enhance the capabilities of an ELVISS software prototype to allow the empirical investigation of different interface and sensor characteristics on search and detection capability under different simulated environmental conditions.

1.2 Background

DND has identified a requirement to enhance the capabilities of Search And Rescue (SAR) operators to conduct operations at night and under degraded weather conditions. To this end, the Defence Research Establishment Valcartier (DREV) is developing a multi-sensor system composed of an Active Imaging System (the Airborne Laser-Based Enhanced Detection and Observation System (ALBEDOS)) and a thermal Infrared (IR) imaging system. By coordinating the use of a pulsed laser illuminator and AGTV camera, the AGTV component of ELVISS provides effective imaging in the absence of ambient light. In addition, the active range gate allows the AGTV system to penetrate meteorological phenomena such as fog, snow and rain much more effectively than a FLIR camera. The FLIR camera is a passive thermal imaging system that produces an image based on temperature variation by detecting mid-infrared and far-infrared radiation. Both sensors are boresighted and are packaged in a gimballed "ball" that is mounted on the exterior of an aircraft or vehicle.

In order to ensure that a SAR operator would be able to use the system effectively and with a minimal amount of training, a prototype human-machine interface (HMI) was developed to evaluate design concepts. Two key software packages were utilized to develop the prototype: Virtual Prototypes, Inc.'s (VPI) Virtual Applications Prototyping System (VAPS) and Silicon Graphics, Inc.'s (SGI) IRIS Performer. VAPS was utilized to prototype the 2D elements of the HMI while Performer was used to render a 3D visualization of the virtual mission world in order to simulate dynamic AGTV and FLIR sensor imagery. Performer was also used to generate a moving map display for the HMI.

The ELVISS HMI prototype represented a potentially cost effective way of evaluating operator performance with respect to a candidate user interface. The initial prototype, however, had only a limited capability to record objective data and did not provide sufficient capability to develop experimental scenarios or to manipulate sensor and interface characteristics.

1.3 Aim

The aim of this report is to provide instructions for installation and use of software developed to support empirical investigation of a simulated user interface for the ELVISS.

1.4 Objectives

The specific objectives of this report are to:

Describe the process of installing the ELVISS Prototype System;

Provide instructions on the use of the ELVISS Scenario Generation Environment (SGE) and the ELVISS Human Machine Interface (HMI) Prototype software; and

Provide specifications for the various file formats employed by the ELVISS Prototype System.

1.5 Scope

This report addresses the modification of existing ELVISS prototype software as well as the creation of new software to support the generation of experimental scenarios.

1.6 Report Outline

The report is structured as follows:

Section One describes the background, aim and scope of this document;

Section Two explains the process of installing the ELVISS Prototype Software;

Section Three documents the use of the ELVISS Scenario Generation Environment (SGE) and ELVISS HMI Prototype software;

Section Four documents the use of the ELVISS Human Machine Interface (HMI) Prototype software; and

Section Five documents the specifications for various files employed by the SGE and HMI Prototype.

2. Installation

2.1 General

The following subsections describe the process of installing the ELVISS Software Prototype and supporting software. The instructions in this section assume a basic working knowledge of the SGI IRIX operating system. The instructions also assume that you have logged onto the system and have read and write privileges for the target directory into which you intend to install the ELVISS Prototype Software.

2.2 Before You Begin

Before you begin installing the ELVISS Software Prototype:

- Ensure that the system requirements defined in the ELVISS Software Prototype System Manual have been met.
- Ensure that you have adequate permissions to write data to the target directories into which you intend to install the software.

2.3 Installing the ELVISS Prototype Software

1. Insert the ELVISS Prototype Software CD into your CD-ROM drive.
2. By default, the operating system will have auto mounted the CD-ROM. Otherwise, manually mount the CD-ROM.
3. Copy the tar-compressed image located in the prototype directory to the target directory into which you intend to install the ELVISS Prototype Software.

For example, to copy the tar-compressed image from the CD-ROM drive to the `/usr/people/elviss` directory (assuming the CD-ROM drive has been mounted on `/CDROM`):

```
cp /CDROM/prototype/elviss.tar.Z /usr/people/elviss
```

4. Change to target directory and uncompress the image:

```
cd /usr/people/elviss
```

```
uncompress elviss.tar.Z
```

5. Un-tar the archive:

```
tar -xvf elviss.tar
```

6. The ELVISS directory will have been created and populated with an image of the ELVISS Prototype Software directory structure.
7. It is now safe to delete the remaining `elviss.tar` file from the target directory:

```
rm elviss.tar
```

2.4 Environment Variables

Before you run the ELVISS SGE or the ELVISS HMI Prototype, add the following environment variable to your `.cshrc` file so that it is set for future sessions:

```
setenv ELVISS_HOME /usr/people/elviss/ELVISS
```

(Assuming that `/usr/people/elviss` is the target directory for ELVISS Prototype Software.)

Also add the following line to your `.cshrc` file so as to simplify the process of launching the ELVISS software:

```
set PATH = ${PATH}:${ELVISS_HOME}/bin
```

Additional environment variables are used to configure various elements of the ELVISS Prototype System. Annex C includes a complete list of environment variables for the ELVISS Prototype System.

2.5 ELVISS Software Directory Structure

When you un-tarred the ELVISS archive in Section 2.3, a directory structure was created. This directory structure encapsulates various components of the ELVISS Prototype software and contains the source code, binary executables and data sets required to compile and execute the ELVISS Prototype software. Figure 1 describes the ELVISS directory structure.

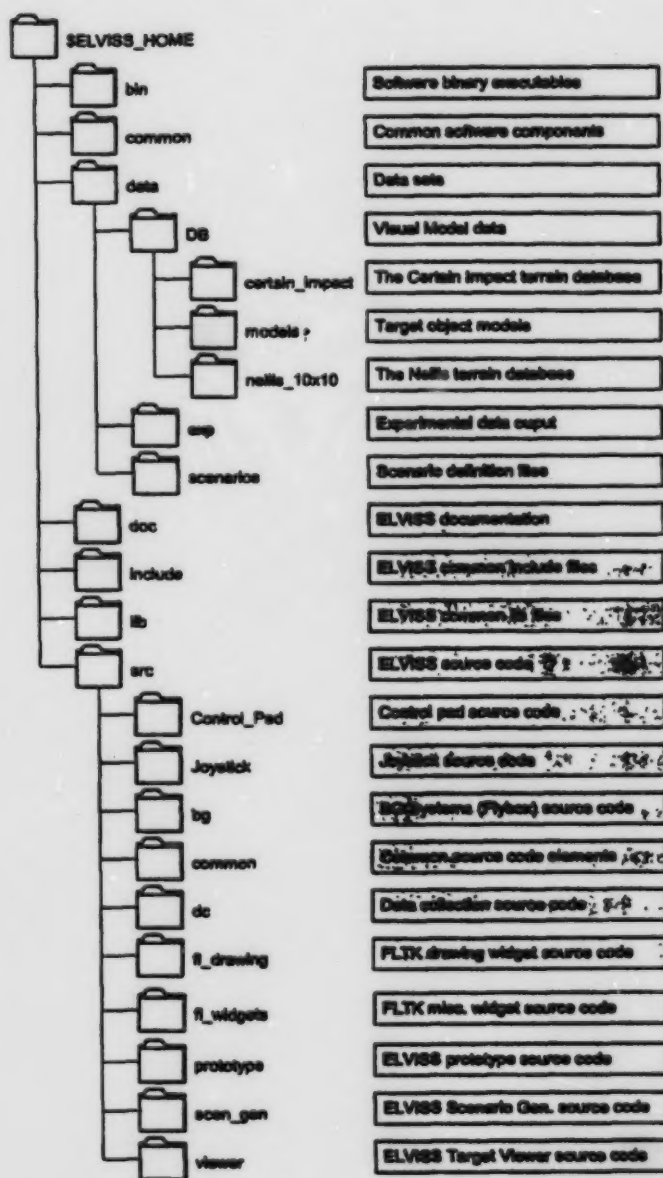


Figure 1. ELVISS Software Directory Structure

2.6 Installing the Acrobat Reader Software

The Adobe Acrobat Reader is required to view the PDF format of the ELVISS documentation set. If you already have the Acrobat Reader executable (`acroread`) installed on your system, make sure that the executable is located in one of the directories specified by the `PATH` environment variable.

If the software is not installed on your system, you can install the version provided on the CD-ROM in the `utils` directory. This version is a compressed tar archive. Uncompress it in one of the directories specified by the `PATH` variable, and follow the instruction in `INSTGUID.TXT` to install the Acrobat Reader.

3. The Scenario Development Process

The ELVISS Prototype System contains two components which were created with the intent of facilitating the empirical investigation of different interface and sensor characteristics on search and detection capability under different simulated environmental conditions :

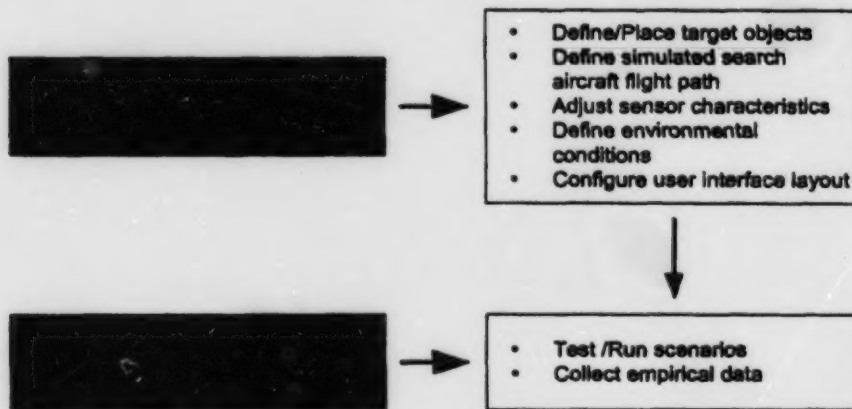


Figure 2. Scenario Development Process

3.1 The Scenario Generation Environment

The Scenario Generation Environment (SGE) allows you to:

- Define a scenario landscape (terrain).
- Place target objects on the scenario landscape.
- Define a flight path for a simulated search aircraft.
- Adjust various simulated sensor characteristics.
- Adjust simulated environmental conditions.
- Configure the layout of the Human Machine Interface (HMI).

The SGE uses a project concept. An ELVISS project is a collection of all the files that together make up an ELVISS experimental scenario. You begin by planning your project and then create various files as you perform the tasks required to build your

experimental scenario. The ELVISS Prototype System uses four files to define a scenario: a target file, a flight plan file, a configuration file and a project file.

- A target file (.tgt) contains the information required to represent the placement and characteristics of all targets for a given scenario.
- A flight plan file (.fp) contains the information required to create a flight path for a simulated search aircraft.
- A configuration file (.cfg) contains various elements of scenario configuration information including a definition of the Scenario Landscape, the configuration of the simulated sensors and the configuration of the HMI Prototype.
- A project file (.prj) contains a reference to a target file, a flight plan file and a configuration file which, when treated as a group, represent a complete ELVISS experimental scenario.

For details on tasks performed using the SGE, please refer to Section 4.

3.2 The Human Machine Interface Prototype

The Human Machine Interface (HMI) Prototype represents a virtual prototype of a proposed ELVISS system interface. This virtual interface allows you to test and evaluate the impact of different interface and sensor characteristics on search and detection tasks by simulating, in real time, scenarios created using the SGE.

The HMI Prototype also collects data on the way that the system was used as well as on the performance of operators in accomplishing the goals set out by the scenario.

For details on using the ELVISS HMI Prototype, please refer to Section 5.

4. The ELVISS Scenario Generation Environment

4.1 Introduction

The ELVISS Scenario Generation Environment (SGE) allows you to define the elements required to create an experimental scenario. The SGE also allows you to preview some elements of the scenario as it is being created.

4.2 Starting and Exiting the SGE

To start the SGE type `run_scen_gen` at the command line and press <Enter>. Alternatively, double click on the `run_scen_gen` icon (shortcut) on the desktop.

To exit the SGE, choose **File | Exit**.

4.3 A quick look at the SGE

Once you start the SGE, you will use various controls to perform your scenario-building tasks:

- The **Moving Map Display (MMD)** and **Toolbar** allow you to navigate the scenario landscape or terrain and scrutinize the placement of objects.
- The **Targets** tab allows you to add and delete targets from the scenario as well as to control the characteristics of the targets.
- The **Aircraft** tab allows you to define a flight path for a simulated search aircraft.
- The **Sensors** tab allows you to control the characteristics of the simulated AGTV and FLIR sensors.
- The **Environment** tab allows you adjust environmental settings for the scenario.
- The **Altitude Profile Display** provides you with information about the altitude of the simulated search aircraft with respect to time.
- The **Scenario Summary** provides you with summary information about the duration of the current scenario and the number of targets/non-targets defined in the current scenario.

The SGE also includes various menus, each with its own set of commands and/or options that you can use to perform functions such as loading/saving scenarios and files, selecting the scenario landscape and previewing targets.

4.4 The SGE Interface

The SGE interface consists of a single window that is divided into five main areas and a menu bar, as illustrated below. The options provided in the pull-down menus are described in the following sections.

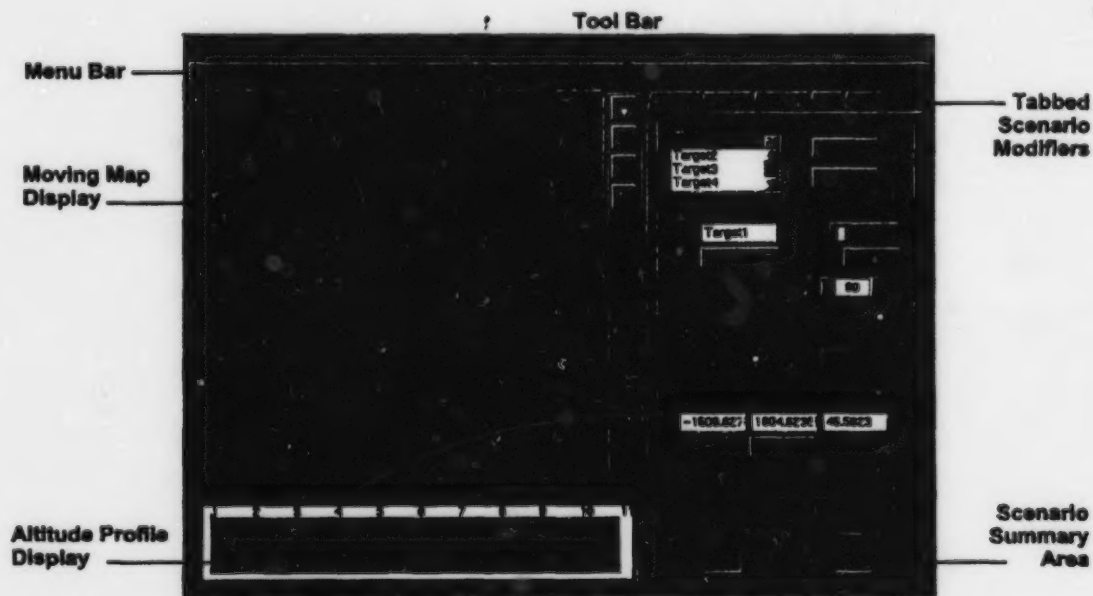


Figure 3. SGE Interface

4.5 Using the ELVISS SGE

The following sections will provide information about using the SGE to perform the standard tasks required to build ELVISS experimental scenarios.

4.5.1 Defining a Scenario Landscape (Terrain)

Each ELVISS experimental scenario is based on a Scenario Landscape or terrain database. To open a Scenario Landscape, use **Terrain | Select...** in the SGE window. Scenario Landscape files may be recognized by the .pfb file extension. Navigate to the appropriate directory and select the file that

you want to open, and click OK. The selected Scenario Landscape appears in the Moving Map Display (MMD) area.

Two terrain databases are supplied with the ELVISS Prototype software: the Certain Impact database and the Nellis 10kmx10km database. To use the Certain Impact database, follow the instructions in the preceding paragraph and navigate to "certain_impact/models" and select "terrain.pfb". To use the Nellis 10x10 database, follow the instructions in the preceding paragraph and navigate to "nellis_10x10/models" and select "Final_Targetv1.pfb".

When navigating the directories that contain terrain data you will find two files: one with "_bw" in the name and one without (i.e. terrain.pfb and terrain_bw.pfb). The file name that contains "_bw" is the black and white version of the terrain database – this version **should not** be used in the SGE. Instead, use the file without "_bw" in the file name – this is the colour version of the terrain database and **should** be used in the SGE.

4.5.2 Using the Moving Map Display

The SGE allows you to navigate the Scenario Landscape via the Moving Map Display (MMD) and associated Toolbar. The main purpose of the MMD is to provide a visual overview of the experimental scenario and to facilitate accurate placement of scenario elements (targets and waypoints) on the Scenario Landscape. The MMD provides two modes of map navigation: panning and zooming.

To pan around the map, place the cursor overtop the MMD and depress the left mouse button. While the left mouse button is depressed, you may pan around the map by moving the cursor towards the outer borders of the MMD. For example, moving the cursor towards the right border of the MMD will cause the map to pan to the right. The rate of pan is directly related to the distance of the cursor from the centre of the MMD.

To zoom in and out of the map, place the cursor overtop the MMD and depress the right mouse button. While the right mouse button is depressed, you may zoom in and out of the map based on the position of the cursor in the MMD. Placing the cursor in the top half of the MMD will cause the MMD to zoom in, while moving the cursor into the bottom half of the MMD will cause the MMD to zoom out. The rate of zoom is directly related to the distance of the cursor from the centre of the MMD.

At any time you may revert to the initial pan and zoom settings of the MMD by placing the cursor overtop the MMD and clicking the middle mouse button.

4.5.2.1 The MMD Toolbar

The MMD Toolbar provides additional tools to facilitate the manipulation of the MMD. The Toolbar provides such functions as *Grab*, *Centre On*, *Step Zoom In* and *Step Zoom Out*.

The Grab tool provides an easy means to navigate the Scenario Landscape by allowing the user to grab and drag the terrain in any direction. To use the Grab tool, simply click on the Grab tool icon. The standard cursor will be replaced by the Grab cursor when position over the MMD. Now use the left mouse button to select a drag point on the terrain and with the left mouse button depressed, move the mouse in any direction to drag the terrain. The Grab tool mode is persistent, so when you have finished repositioning the terrain, de-select the grab tool by clicking on the Grab tool icon. The Grab tool cursor will be replaced by the default cursor.

The Centre-On tool allows you to select a point on the Scenario Landscape that you wish to specify as the new "centre" for the MMD. To use the Centre-On tool, click the Centre-On tool icon. The standard cursor will be replaced by the Centre-On cursor. Use the mouse to position the Centre-On cursor over the position that you would like to specify as the new centre for the MMD and click the left mouse button to re-centre the map. The Centre-On tool is a "one-shot" operation, so if you would like to specify a new centre, you will have to re-select the Centre-On tool. The Centre-On function is particularly useful when you wish to quickly zoom in on a specific position on the terrain: rather than having to use a combination of Grab and Zoom actions simply centre on the area of interest and use the Step Zoom functions to achieve the desired zoom level.

The Step Zoom In and Step Zoom Out tools allow you to quickly zoom in and out on the MMD in an incremental fashion. To Step Zoom In: click on the Step Zoom In icon. To Step Zoom Out: click on the Step Zoom Out icon. The zoom function will halve the current zoom setting or double the current zoom setting, as appropriate.

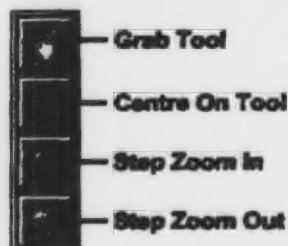


Figure 4. MMD Toolbar Functions

4.5.3 Manipulating Targets

Target objects form the basis for the search and detection task utilized in the empirical investigation of ELVISS user interface issues. A target is a three-dimensional object or 3D model with certain scenario related characteristics assigned to it by the user. Targets may be added or deleted from a scenario. The target manipulation interface is presented in Figure 5.



Figure 5. Target Manipulation Interface

4.5.3.1 Adding a Target

1. In the tabbed area select Targets. The target manipulation area will be displayed.
2. In the Targets area, add a target by clicking the Add button. A new target will appear in the target browser. It will have been assigned a default name of "Target1".
3. At this point a target icon will not have appeared on the MMD. This is because no position has been defined for the newly created target. To define a geographic position for the target, click the Select button in the Position area and then select a location on the Scenario Landscape by clicking on the MMD in the location where you'd like the target to be placed.
4. A target icon will appear on the MMD over the clicked position to indicate the selected location for the target. Target icons appear as boxes containing an "x" symbol".



4.5.3.2 Deleting a Target

1. In the tabbed area, select **Targets** if it is not already selected. The target manipulation area will be displayed.
2. Select the target you wish to delete via the target browser. It will become highlighted.
3. Delete the target by clicking the **Delete** button.

4.5.3.3 Modifying Target Parameters

Each target has a number of parameters that will affect the way the target will be utilized by the ELVISS HMI Prototype. The following table describes the various target parameters and how to manipulate them.

Table 1. Target Parameters

PARAMETER NAME	DESCRIPTION	USE
Name	Assigns an alpha-numeric name to the target. The name is used to identify the target on the MMD.	Select the Name field and type a desired name. When finished, press the <Enter> key to apply the new name.
Target	Flags this object as being a "Target" object (as opposed to a non-target). This parameter is used for scoring purposes when an HMI Prototype user has been asked to discriminate between true target objects and false target objects.	Click on the Target radio button to toggle the target setting. Notice that the colour of the target icon on the MMD will toggle between red and green. Red indicates that the target has been flagged as a true target. Green signifies a false target.
Retro-Reflective	Flags this object as having "retro-reflective" characteristics. This parameter will affect the presentation of the target when observed in the HMI Prototype: the target will appear to "reflect" the light emitted by the laser illuminator when the beam is positioned on the target.	Click on the Retro-Reflective radio button to toggle the retro-reflective setting. Illuminated indicates retro-reflective property enabled.
Type	Defines the visual representation of the target (people, vehicles, aircraft or geometric primitives).	Select a type from the Type pick list. A detailed description of target types is provided in Appendix TBD.
Visibility	Defines the visibility of target with respect to the simulated AGTV and FLIR sensors.	Select a visibility setting from the Visibility pick list. Both signifies the target will be visible to both the simulated AGTV and FLIR sensors. AGTV Only means that the target will be visible to the simulated AGTV only and will not be visible by the FLIR. FLIR Only means that the target will only be visible to the simulated FLIR sensor and will not be visible to the AGTV sensor.
Orientation	Assigns an orientation or heading to the target object allowing it to be rotated to face in any	Adjust the Orientation dial to specify the desired orientation of the object.

	direction. A heading of 0 is equivalent to due North.	Alternatively, you may increment or decrement the orientation value via the Orientation spin box.
Colour	Allows you to modify the runtime colour of the target object as it will appear to the AGTV and FLIR sensors. The light on the Colour button determines if the target colour has been modified (lit) or if the default target colour is being used (unlit).	Click the Colour button to display the target colour manipulation window. Use the Enable Colour Adjustment radio buttons to enable/disable colour adjustment for the current target as it will be viewed by the AGTV and FLIR sensors. When colour adjustment is enabled, use the slider to adjust the target colour between Dark and Light. When you have finished adjusting target colour settings, click OK to keep your changes or Cancel to discard any changes you have made.
Identifier	Flags this object as being enhanced by an identifier label. An identifier label takes the form of a billboard "sign" that will be presented above the target model representation when viewed in the HMI Prototype.	Click the Identifier radio button to select/deselect the target identifier setting.
Label	When the Identifier is enabled, Label defines the alpha-numeric character that will be visible on the Identifier billboard.	Select an alpha-numeric value from the Label pick-list. This parameter will only have an effect if the Identifier parameters have been enabled.
Position	Assigns the geographic location of the target object on the scenario landscape. The position is specified by an x, y, and z value. These values are in meters.	The target position may be selected interactively by clicking the Select button and then clicking on a location on the MMD. Alternatively, you may select and type discrete values into the x, y and z fields and then hit <Enter> to apply the new value(s).

4.5.3.4 Previewing Target Placement and Appearance

The SGE allows you to preview the placement and appearance of the targets that you have created. This feature is particularly useful when accurate placement of objects with respect to the surrounding terrain is desired (i.e. placing an object between two buildings, behind a hill, etc.).

To preview a target, click on the target name in the target browser and select **Target | Preview** on the menu bar. The Target Preview Utility will launch and display the selected target. The Target Preview Utility is presented in Figure 6.



Figure 8. Target Preview Utility (Automatic Mode)

The default mode of operation for the Target Preview Utility is to place the point of observation on a circular orbit about the target. The default mode of operation may be overridden by selecting **View | Manual** on the Target Preview Utility menu bar. Selecting the manual mode of viewing will expand the size of the Target Preview Utility window and present you with a number of controls that allow you to manually manipulate the point of observation. You may manipulate the azimuth, elevation and distance of the point of observation from the target via the **Azimuth**, **Elevation** and **Distance** slider controls located in the Target Preview Utility window. Azimuth and elevation are measured in degrees while the distance parameter is measured in meters. The Target Preview Utility (with manual view mode selected) is presented in Figure 7.



Figure 7. Target Preview Utility (Manual Mode)

When you are finished previewing the target, select **File | Exit** in Target Preview Utility window.

4.5.3.5 Saving the Target List

Whenever you make changes to your targets you will want to preserve those changes by saving the target list. To save the target list, select **File | Save Targets** on the SGE window menu bar. Use the file browser to navigate to the desired directory and type in a file name (remember that your target file must end with a .tgt extension). Click **OK** to save the target file. Alternatively you may wish to overwrite an existing target file. In this case use the file browser to navigate to the directory that contains the file that you wish to overwrite. Select the file and click **OK** – the SGE will warn you that you are about to overwrite an existing file. If this is indeed what you wish to do then click **OK** to overwrite the existing file.

4.5.3.6 Loading an Existing Target List

To load an existing target list, select **File | Open File** on the SGE window menu bar. Use the file browser to navigate to the directory that contains the existing target (.tgt) file. Select the desired target file and click **OK**. The SGE will load the target list contained in the target file.



4.5.4 Manipulating the Aircraft Flight Path

In order to represent the use of the ELVISS from an airborne platform, the ELVISS Prototype System allows you to define a flight path for a simulated search aircraft to which the simulated sensors are affixed. The SGE allows you to select one of three types of flight paths: a User Defined flight path, a Creeping Line Ahead flight pattern and an Expanding Square flight pattern.

4.5.4.1 User Defined Flight Path

The User Defined flight path allows you to create a flight path made up of a sequence of waypoints that are individually placed according to your specifications. You may specify the location, altitude and speed of the simulated search aircraft at each waypoint. The User Defined flight path manipulation interface is presented in Figure 8.

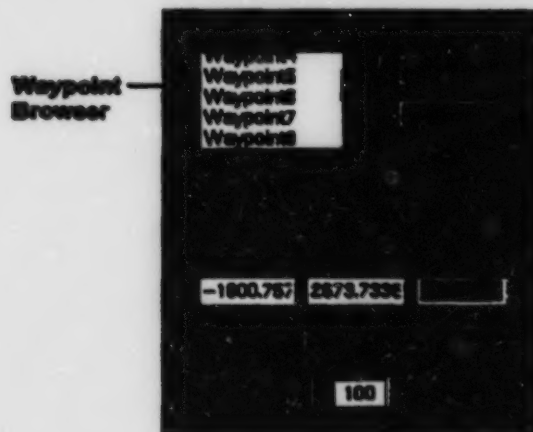


Figure 8. User Defined Flight Path Manipulation Interface

4.5.4.2 Adding a Waypoint

1. In the tabbed area select Aircraft then select the User Defined tab. The User Defined flight path manipulation area will be displayed.
2. In the Flight Plan area, add a waypoint by clicking the Add button. A new waypoint will appear in the Waypoint Browser. The SGE will automatically assign a name to the waypoint (i.e. "Waypoint1").
3. At this point a waypoint icon will not have appeared on the MMD. This is because no position has been defined for the newly created waypoint. To define a geographic position for the waypoint, click the Select button in the Position area and then select a location on the Scenario Landscape

by clicking on the MMD in the location where you'd like the waypoint to be placed.

4. A waypoint icon will appear on the MMD over the clicked position to indicate the selected location for the waypoint. Waypoint icons appear as cyan coloured stars. Once more than one waypoint has been defined, the flight path will appear on the MMD as a white line connecting waypoint to waypoint.
5. New waypoints will be created at ground level by default. You should assign a desired absolute altitude to the new waypoint by selecting the Altitude field in the Position area, entering an altitude value and pressing *Enter*. To assist you in this task, you may wish to use the Altitude Profile Display (discussed in section 4.5.8). The Altitude Profile Display provides you with information about the relative altitude of your waypoint from ground level.



4.5.4.3 Deleting a Waypoint

1. In the tabbed are select Aircraft if it is not already selected. The flight path manipulation area will be displayed.
2. Select the waypoint you wish to delete via the Waypoint Browser. It will become highlighted.
3. Delete the waypoint by clicking the Delete button. Any remaining waypoint will automatically be re-named to ensure a continuous sequence of numbers in the flight plan.

4.5.4.4 Modifying Waypoint Parameters

Each waypoint has a number of parameters that will affect the way the waypoint will be utilized by the ELVISS HMI Prototype. The following table describes the various waypoint parameters and how to manipulate them.

Table 2. User Defined Waypoint Parameters

PARAMETER NAME	DESCRIPTION	USE
Position	Assigns the geographic location of the waypoint object on the scenario landscape. The position is specified by an x, y, and Altitude value. These values are in meters.	The waypoint position may be selected interactively by clicking the Select button and then clicking on a location on the MMD. Alternatively, you may

	values are in meters.	select and type discrete values into the x, y and Altitude fields and then hit <Enter> to apply the new value(s).
Speed	Assigns a speed to the simulated search aircraft once it reaches that waypoint. Speed is specified in knots.	Click on the increment or decrement controls on the Speed spin box to increase or decrease the speed of the simulated search aircraft.

4.5.4.5 *Creeping Line Ahead Flight Pattern*

The SGE allows you to generate flight patterns that are commonly employed by the search and rescue community. The "Creeping Line Ahead" is one of these patterns. The "Creeping Line Ahead" comprises a pattern of equally spaced parallel lines. It is a general search pattern that attempts to ensure even search coverage over a designated search area. A "Creeping Line Ahead" pattern is depicted in Figure 9.



Figure 9. Creeping Line Ahead Search Pattern

By providing some elementary parameter values, the SGE will automatically generate a sequence of waypoints for you.

4.5.4.6 *Creating a Creeping Line Ahead Flight Pattern*

To create a Creeping Line Ahead flight pattern:

1. In the tabbed area select **Aircraft** then select the **Creeping Line** tab. The Creeping Line Ahead flight path manipulation area will be displayed.

2. In the Start Point area, designate the start point for the pattern by clicking the Select button and then select a location on the MMD. The Creeping Line Ahead flight pattern will be displayed on the MMD configured with default parameter values.

4.5.4.7 Modifying the Creeping Line Ahead Flight Pattern

The Creeping Line Ahead flight pattern is created based on a number of parameters. Changing these parameters will affect the geographic area that the pattern will cover and the rate at which the area is covered. The following table describes the various parameters that affect the Creeping Line Ahead flight pattern and how to modify them. The Creeping Line Ahead manipulation interface is depicted in Figure 10.

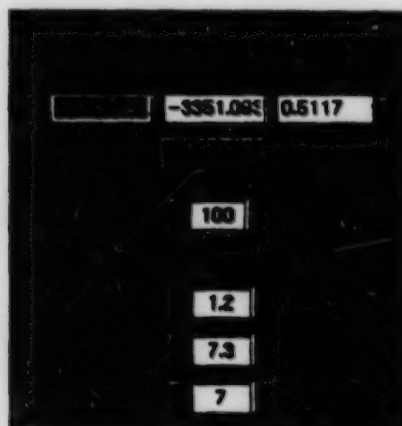


Figure 10. Creeping Line Ahead Flight Pattern Manipulation Interface

Table 3. Creeping Line Ahead Parameters

PARAMETER NAME	DESCRIPTION	USE
Position	Assigns the geographic location of the starting point for the flight pattern. The position is specified by an x, y, and Altitude value. These values are in meters.	The Start Point position may be selected interactively by clicking the Select button and then clicking on a location on the MMD. Alternatively, you may select and type discrete values into the x, y and Altitude fields and then hit <Enter> to apply the new value(s).
Speed	Defines the speed at which the simulated search aircraft will fly the flight pattern.	Click on the increment or decrement controls on the Speed spin box to increase or decrease the speed of the simulated search aircraft.

S	Represents the separation between the flight legs that make up the pattern. S is measured in kilometres.	Click on the increment or decrement controls on the S spin box to increase or decrease the leg separation.
Leg Length	Represents the length of the flight legs that make up the pattern. Leg Length is measured in kilometres.	Click on the increment or decrement controls on the Leg Length spin box to increase or decrease the length of the flight legs.
# of Legs	Assigns the number of flight legs that will make up the flight pattern.	Click on the increment or decrement controls on the # of Legs spin box to increase or decrease the number of legs that make up the pattern.

Figure 11 describes the Creeping Line Ahead flight pattern and the parameters used to generate it.

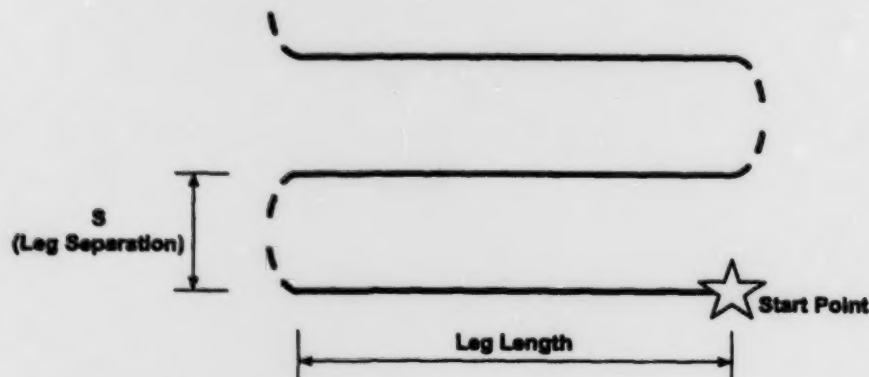


Figure 11. Creeping Line Ahead Parameters

4.5.4.8 Expanding Square Flight Pattern

The "Expanding Square" is another commonly used search pattern. It is made up of a pattern of progressively larger squares (a "square spiral"). The "Expanding Square" flight pattern is a more specialized search pattern employed when the general location of the object or person being searched for is known and the search crew wishes to concentrate around that area. An "Expanding Square" flight pattern is depicted in Figure 12.



Figure 12. Expanding Square Search Pattern

By providing some elementary parameter values, the SGE will automatically generate a sequence of waypoints for you.

4.5.4.9 Creating an Expanding Square Flight Pattern

To create an Expanding Square flight pattern:

1. In the tabbed area select Aircraft then select the Expanding Square tab. The Expanding Square flight path manipulation area will be displayed.
2. In the Start Point area, designate the start point for the pattern by clicking the Select button and then select a location on the MMD. The Expanding Square flight pattern will be displayed on the MMD configured with default parameter values.

4.5.4.10 Modifying the Expanding Square Flight Pattern

The Expanding Square flight pattern is created based on a number of parameters. Changing these parameters will affect the geographic area that the pattern will cover and the rate at which the area is covered. The following table describes the various parameters that affect the Expanding Square flight pattern and how to modify them. The Expanding Square manipulation interface is depicted in Figure 13.

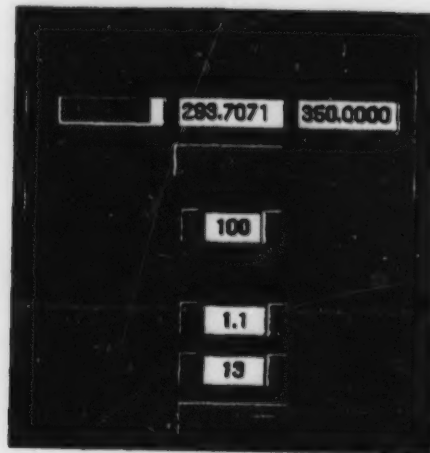


Figure 13. Expanding Square Flight Pattern Manipulation Interface

Table 4. Expanding Square Parameters

PARAMETER NAME	DESCRIPTION	USE
Position	Assigns the geographic location of the starting point for the flight pattern. The position is specified by an x, y, and Altitude value. These values are in meters.	The Start Point position may be selected interactively by clicking the Select button and then clicking on a location on the MMD. Alternatively, you may select and type discrete values into the x, y and Altitude fields and then hit <Enter> to apply the new value(s).
Speed	Defines the speed at which the simulated search aircraft will fly the flight pattern.	Click on the increment or decrement controls on the Speed spin box to increase or decrease the speed of the simulated search aircraft.
S	Represents the separation between the flight legs that make up the pattern. S is measured in kilometres.	Click on the increment or decrement controls on the S spin box to increase or decrease the leg separation.
# of Legs	Assigns the number of flight legs that will make up the flight pattern.	Click on the increment or decrement controls on the # of Legs spin box to increase or decrease the number of legs that make up the pattern.
Direction	Dictates the direction of the first turn that is made in the pattern. The direction may be clockwise or counter-clockwise.	Select the desired direction from the Direction pick-list.

Figure 14 describes the Expanding Square flight pattern and the parameters used to generate it.

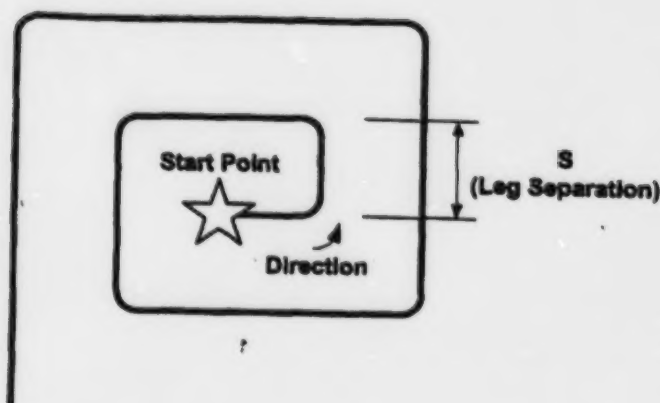


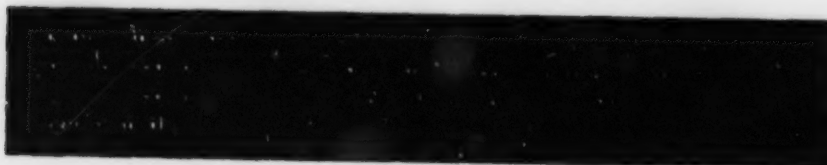
Figure 14. Expanding Square Parameters

4.5.4.11 Saving a Flight Plan

Whenever you make changes to your flight plan you will want to preserve those changes by saving the flight plan. To save the flight plan, select **File | Save Flight Plan** on the SGE window menu bar. Use the file browser to navigate to the desired directory and type in a file name (remember that your flight plan file must end with a .fp extension). Click OK to save the flight plan. Alternatively you may wish to overwrite an existing flight plan file. In this case use the file browser to navigate to the directory that contains the file that you wish to overwrite. Select the file and click OK – the SGE will warn you that you are about to overwrite an existing file. If this is indeed what you wish to do then click OK to overwrite the existing file.

4.5.4.12 Loading an Existing Flight Plan

To load an existing flight plan, select **File | Open File** on the SGE window menu bar. Use the file browser to navigate to the directory that contains the existing flight plan (.fp) file. Select the desired flight plan file and click OK. The SGE will load the flight plan contained in the flight plan file.



4.5.5 Manipulating Sensors

At the core of the ELVISS are two electro-optical sensors: an AGTV and a FLIR. The SGE allows you to control a number of sensor parameters. These parameters affect the way the simulated sensors will operate, as well as the

way in which they will be presented in the HMI Prototype. The sensor manipulation interface is presented in Figure 15.

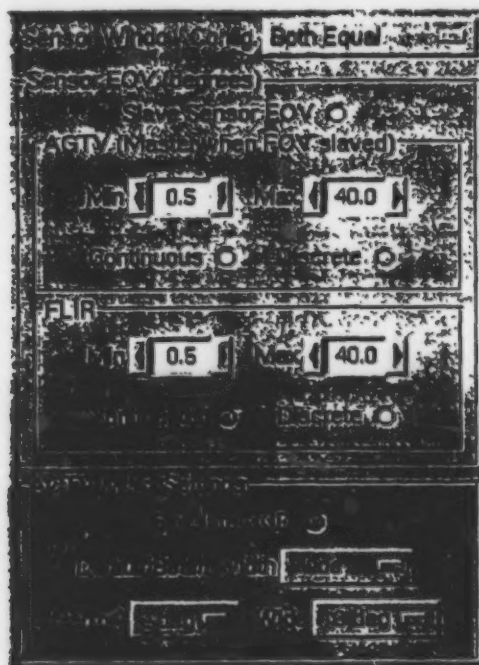


Figure 15. Sensor Manipulation Interface

The following table describes the various sensor parameters and how to modify them.

Table 5. Sensor Parameters

PARAMETER NAME	DESCRIPTION	USE
Sensor Window Configuration	Controls the layout of the sensor video presentation in the HMI Prototype. Valid settings are "Both Equal", "AGTV Primary", "FLIR Primary", "AGTV Only" AND "FLIR Only".	Select the desired sensor window configuration from the Sensor Window Configuration pick-list.
Slave Sensor FOV	"Slaves" the FLIR sensor FOV to that defined for the AGTV.	Click on the Slave Sensor FOV radio button to toggle the FOV slave setting.
AGTV Min	Assigns the minimum allowable AGTV FOV that may be achieved in the HMI Prototype.	Click on the increment or decrement controls of the Min spin box to increase or decrease the minimum sensor FOV.
AGTV Max	Assigns the maximum allowable AGTV FOV that may be achieved in the HMI Prototype.	Click on the increment or decrement controls of the Max spin box to increase or decrease the maximum sensor FOV.

AGTV Continuous	Defines the zoom control for the AGTV (in the HMI Prototype) to be a continuous range between the AGTV Minimum FOV and the AGTV Maximum FOV.	Click on the Continuous radio button to toggle the FOV setting between "Continuous" and "Discrete".
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AGTV Discrete	Defines the zoom control for the AGTV (in the HMI Prototype) to be a discrete setting. This discrete setting may be selected at runtime by the HMI Prototype operator to be the AGTV Minimum FOV or the AGTV Maximum FOV.	Click on the Discrete radio button to toggle the FOV setting between "Continuous" and "Discrete".
FLIR Min	Assigns the minimum allowable FLIR FOV that may be achieved in the HMI Prototype.	Click on the increment or decrement controls of the Min spin box to increase or decrease the minimum sensor FOV. This control has no effect when Slave Sensor FOV is selected.
FLIR Max	Assigns the maximum allowable FLIR FOV that may be achieved in the HMI Prototype.	Click on the increment or decrement controls of the Max spin box to increase or decrease the maximum sensor FOV. This control has no effect when Slave Sensor FOV is selected.
FLIR Continuous	Defines the zoom control for the FLIR (in the HMI Prototype) to be a continuous range between the FLIR Minimum FOV and the FLIR Maximum FOV.	Click on the Continuous radio button to toggle the FOV setting between "Continuous" and "Discrete". This control has no effect when Slave Sensor FOV is selected.
FLIR Discrete	Defines the zoom control for the FLIR (in the HMI Prototype) to be a discrete setting. This discrete setting may be selected at runtime by the HMI Prototype operator to be the FLIR Minimum FOV or the FLIR Maximum FOV.	Click on the Discrete radio button to toggle the FOV setting between "Continuous" and "Discrete". This control has no effect when Slave Sensor FOV is selected.
Simulate CCD	Enables/Disables the simulation of a CCD camera in place of the AGTV sensor simulation.	Click on the Simulate CCD radio button to toggle the CCD simulation setting between enabled (lit) and disabled (unlit).
Default Beam Width	Defines the default setting for the simulated laser illuminator beam width. The operator may override the default setting at runtime. Valid beam widths are "Wide" and "Narrow".	Select the desired default beam width from the Default Beam Width selection list.
Narrow	Defines the size (in degrees) of the laser illuminator beam when the AGTV is operated in "Narrow" FOV mode. Valid settings are 2° and 5°.	Select the desired illuminator beam size from the Narrow selection list.
Wide	Defines the size (in degrees) of the laser illuminator beam when the AGTV is operated in "Wide" FOV mode. Valid settings are 10°, 15° and 20°.	Select the desired illuminator beam size from the Wide selection list.

4.5.5.1 Saving the Sensor Configuration

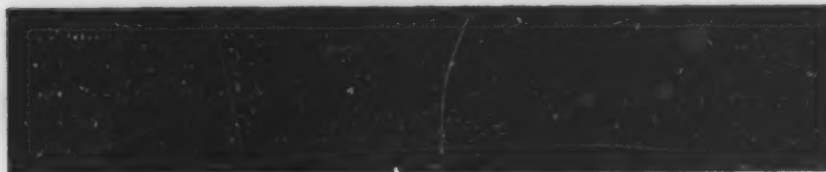
Whenever you make changes to your sensor configuration you will want to preserve those changes by saving the scenario configuration settings. Unlike the target and flight plan parameters; the sensor configuration is saved together with the environmental settings and the Scenario Landscape

definition. So keep in mind, when you are saving the sensor configuration, you are also saving those settings.

To save the sensor configuration, select **File | Save Config** on the SGE window menu bar. Use the file browser to navigate to the desired directory and type in a file name (remember that your configuration file must end with a .cfg extension). Click **OK** to save the configuration. Alternatively you may wish to overwrite an existing configuration file. In this case use the file browser to navigate to the directory that contains the file that you wish to overwrite. Select the file and click **OK** – the SGE will warn you that you are about to overwrite an existing file. If this is indeed what you wish to do then click **OK** to overwrite the existing file.

4.5.5.2 Loading an Existing Sensor Configuration

To load an existing configuration, select **File | Open File** on the SGE window menu bar. Keep in mind that the configuration file also contains environment and scenario landscape information. Use the file browser to navigate to the directory that contains the existing configuration (.cfg) file. Select the desired configuration file and click **OK**. The SGE will load the configuration contained in the configuration file.



4.5.6 Manipulating the Environment

The SGE allows you to control various simulated weather parameters. These parameters will impact on the effectiveness of the simulated sensors in the HMI Prototype. The environment manipulation interface is presented in Figure 16.

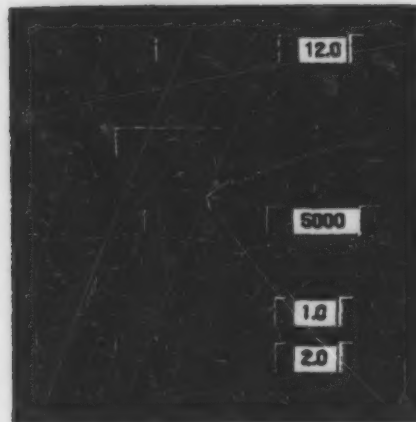


Figure 16. Environment Manipulation Interface

The following table describes the various environment parameters and how to modify them.

Table 6. Environment Parameters

PARAMETER NAME	DESCRIPTION	USE
Time of Day (TOD)	Controls the amount of ambient light illuminating the Scenario Landscape. Time of Day is measured on a scale from 0.0 to 1.0. A value of 0.0 represents complete darkness while a value of 1.0 represents maximum illumination.	Select the desired TOD setting by positioning the Time of Day slider. Alternatively, you may increment or decrement the TOD via the Time of Day spin box.
Visibility	Defines the visibility setting for the experimental scenario. Valid selections are "Clear" and "Foggy".	Select the desired visibility setting via the Visibility pick-list.
Fog Range	Controls the visibility range to complete obscuration by fog. The Fog Range is measured in meters.	Select the desired Fog Range setting by positioning the Fog Range slider. Alternatively, you may increment or decrement the Fog Range via the Fog Range spin box. The Fog Range will only take effect when the Visibility has been set to "Foggy".
AGTV Weather Effect	Controls the effectiveness of the simulated AGTV sensor in penetrating the weather. A setting of "1" represents the penetration capability of the naked eye. A setting of "2" represents twice the penetration capability of the naked eye, etc.	Click on the increment or decrement controls of the AGTV Weather Effect spin box to increase or decrease the weather effectiveness of the simulated AGTV sensor.
FLIR Weather Effect	Controls the effectiveness of the simulated FLIR sensor in penetrating the weather. A setting of "1" represents the penetration capability of the naked eye. A setting of "2" represents twice the penetration capability of	Click on the increment or decrement controls of the FLIR Weather Effect spin box to increase or decrease the weather effectiveness of the simulated FLIR sensor.

	the naked eye, etc.	FLIR sensor.
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4.5.6.1 Description of the « Fog » Weather Effect

Computer images often appear unrealistically sharp and well defined. By adding a "fogging" effect, which gives objects the appearance of "fading" into the distance, a more natural looking image may be achieved. "Fog" is a general term that describes various atmospheric effects; it can be used to simulate haze, mist, smoke or precipitation. Fog is an important component in visual simulations where limited visibility needs to be approximated.

When fog is enabled, objects that are farther from the viewpoint begin to fade into the fog colour. In the ELVISS Prototype, the fog colour is implemented in such a way as to approximate the effect on the sensor being represented. AGTV fog is black in colour (red, green and blue or RGB are equal to 0.0, 0.0, 0.0, respectively), while FLIR fog is a light grey (RGB = 0.8, 0.8, 0.8). These colours are then multiplied by the time-of-day (TOD) setting, resulting in a final fog colour being presented to the user.

The fog model implemented for the ELVISS Prototype uses an exponential-squared density function to control the effect of the fog with respect to range. At runtime, the fog colour is blended with the colour of an object using a fog-blending factor – this blending provides for the gradual fade-out with distance. This factor, f , is computed with the following function and then normalized to a range from 0 to 1, where 0 represents the presentation of 100% of the original object colour (close to the viewpoint) and 1 represents 0% of the original object colour (total obscuration by the fog).

$$f = e^{-(density \cdot z)^2}$$

where z is the eye-coordinate distance between the viewpoint and the object centre.

Further details concerning the implementation of fog in OpenGL may be obtained from Neider, Jackie. (1993). *OpenGL Programming Guide*. Addison Wesley.

4.5.6.2 Saving the Environment Configuration

The environment configuration is saved together with the sensor configuration and the Scenario Landscape information. For detailed information on saving the environment configuration, please refer to Section 4.5.5.1 - Saving the Sensor Configuration.

4.5.6.3 Loading an Existing Environment Configuration

The environment configuration is stored together with the sensor configuration and the Scenario Landscape information. For detailed

information on loading the environment configuration, please refer to Section 4.5.5.2 - Loading an Existing Sensor Configuration.

4.5.7 Manipulating Additional Scenario Settings

The SGE allows to you control additional scenario settings. These miscellaneous settings control the default configuration of the HMI Prototype display and of the HMI control hardware. The miscellaneous settings manipulation interface is presented in Figure 17.



Figure 17. Miscellaneous Settings Manipulation Interface

The following table describes the various miscellaneous parameters and how to modify them.

Table 7. Miscellaneous Parameters

PARAMETER NAME	DESCRIPTION	USE
Map Scale	Controls the default scale setting for the HMI Prototype MMD. Valid map scales are "1:50,000" and "1:250,000".	Select the desired map scale setting from the Map Scale pick-list.
Map Orientation	Defines the default orientation setting for the HMI Prototype MMD. Valid map orientations are "North Up", "Aircraft Up" and "Sensor Up".	Select the desired map orientation setting from the Map Orientation pick-list.

Aircraft Symbol	Controls the default symbol used to represent the position and orientation of the simulated search aircraft for the HMI Prototype MMD. Valid aircraft symbols are "Icon 1", "Icon 2" and "Icon 3".	Select the desired aircraft symbol setting from the Aircraft Symbol pick-list.
Scan Enabled	Controls the default state (enabled/disabled) of the automatic sensor scan function in the HMI Prototype.	Select the default state of the scan function: enabled (lit) or disabled (unlit) by clicking on the Scan Enabled radio button.
Scan Rate	Controls the default scan rate of the automatic sensor scan function in the HMI Prototype. Valid scan rates are "1.5 deg/s", "3 deg/s" and "4.5 deg/s".	Select the desired scan rate setting from the Scan Rate pick-list.
Scan Width	Controls the width of the default scan sweep by the automatic sensor scan function in the HMI Prototype. Valid scan widths are "30 deg", "60 deg" and "90 deg".	Select the desired scan width setting from the Scan Width pick-list.
Joystick Mode	Controls the default manipulation mode of the HMI control hardware joystick. Valid manipulation modes are "Aircraft" and "Cursor". When in aircraft mode, pushing forward on the joystick results in the sensor turret pitching down and pulling back on the joystick results in the sensor turret pitching up. When in cursor mode, the pitch control relationship is reversed: pushing forward on the joystick results in the sensor turret pitching up and pulling back on the joystick results in the sensor turret pitching down.	Select the desired joystick mode setting from the Joystick Mode pick-list.
Zoom Control Mode	Controls the default manipulation mode of the HMI control hardware zoom levers. Valid manipulation modes are "Forward = Zoom In" and "Forward = Zoom Out". When in "Forward = Zoom In" mode, pushing forward on the zoom lever results in the sensor zooming in and pulling back on the zoom lever results in the sensor zooming out. When in "Forward = Zoom Out" mode, the zoom control relationship is reversed: pushing forward on the zoom lever results in the sensor zooming out and pulling back on the zoom lever results in the sensor zooming in.	Select the desired zoom control mode setting from the Zoom Control Mode pick-list.

4.5.8 Altitude Profile Display

The Altitude Profile Display provides a graphical representation of the simulated search aircraft altitude profile and terrain elevation profile with respect to the scenario timeline. The data points that create the aircraft altitude profile are a result of the waypoints defined in the flight plan. As such, the numbers represented on the altitude profile correspond to waypoint numbers in the flight plan. The aircraft altitude profile is drawn in blue and

the terrain elevation profile is drawn in green. The altitude profile display is presented in Figure 18.



Figure 18. Altitude Profile Display

4.5.9 The Scenario Summary Area

The Scenario Summary Area provides summary information about the ELVISS experimental scenario that you have created. The summary information includes an estimated time for executing the scenario as well as information about the total number of targets and non-targets defined in the scenario.

4.5.10 Managing Your Projects

A project is a logical means of grouping target information, flight plan information and HMI configuration information (including sensor, environment and scenario landscape information) to form a complete experimental scenario.

4.5.10.1 Saving Your Project

Once you have defined these elements of scenario information, you may preserve the logical grouping by saving your project. To save a project, select **File | Save Project** on the SGE window menu bar. Use the file browser to navigate to the desired directory and type in a file name (remember that your project file must end with a .prj extension). Click **OK** to save the project. Alternatively you may wish to overwrite an existing project file. In this case use the file browser to navigate to the directory that contains the file that you wish to overwrite. Select the file and click **OK** – the SGE will warn you that you are about to overwrite an existing file. If this is indeed what you wish to do then click **OK** to overwrite the existing file.

4.5.10.2 Loading an Existing Project

To load an existing project, select **File | Open Project** on the SGE window menu bar. Use the file browser to navigate to the directory that contains the existing project (.prj) file. Select the desired project file and click **OK**. The SGE will load the project contained in the project file.

4.6 Previewing a Specific Target Object

In previous sections explaining the use of the ELVISS SGE, mention was made of a Target Preview Utility. This utility is typically launched from within the SGE to preview the placement and orientation of target objects.

The Target Preview Utility may be run independently of the SGE. This is particularly useful when you wish to provide a preview of a target object to a subject or colleague but do not wish to run the SGE.

To run the Target Preview Utility type `run_viewer` at the command line and press **<Enter>**. When executed from the command line, the Target Preview Utility will load a default scenario landscape and will automatically display the first target object in the *Target Type* pick list. Selecting **View | Manual** from the Target Preview Utility menu bar will expand the size of the Target Preview Utility window and present you with a number of controls that allow you to manually manipulate the point of observation as well as to choose the target object that you would like to display.

5. Using the ELVISS Human Machine Interface Prototype

5.1 Introduction

The ELVISS HMI Prototype is the simulation of the ELVISS user interface. The HMI Prototype utilizes the data generated by the ELVISS SGE to construct and execute a simulated scenario. The simulated scenario comprises the visualization of a scenario landscape (or terrain) as viewed through a simulated AGTV and simulated FLIR, the population of the terrain with target objects, the flight of a simulated search aircraft over the terrain and the configuration and layout of the HMI itself.

The original HMI Prototype has been modified to incorporate an advanced data collection capability. This data collection capability allows the experimenter to capture important information about the interaction between the operator and the HMI Prototype throughout the execution of an experimental scenario.

The intent is to provide information regarding the execution of the modified HMI Prototype in an experimental context. For a complete description of the ELVISS HMI Prototype and its' use, please refer to Neal, B. (April 28, 1999). *ELVISS Human Engineering Design Approach Document – Operator*. Canadian Marconi Company.

5.2 Starting and Exiting the ELVISS HMI Prototype

The HMI Prototype must be started at the command line. In order for the HMI Prototype to function correctly a number of command line parameters must be provided. Command line parameters are options that are provided to the HMI Prototype application that define the run time behaviour of the application. The syntax for starting the HMI Prototype is as follows:

```
run_elviss project_file [subject_number] [trial_number]
```

Where:

project_file is the path and name of a valid scenario project file (i.e. a file with a .prj extension)

subject_number and *trial_number* are optional numeric parameters used to identify and name the data collection files that will be created by the HMI Prototype.

If *subject_number* and *trial_number* are not provided, the HMI Prototype will assign default values of 0 and 0, respectively. When the subject number and trial number are equal to zero, this is considered to be a special test case by the prototype and data collection software. When this special case is exercised, the software will not warn the user about over-writing existing data – it will simply assume that the user desires a demonstration or wishes to test a scenario – take note: the data will be over-written.

When any other values for subject number and/or trial number are used, the software will assume that the user desires to execute a "real" trial and will warn the user if previously recorded data is going to be over-written. Additional information regarding the data collection component of the HMI Prototype is provided in Section 6.3.

If you have not yet created any scenarios using the ELVISS Scenario Generation Environment (SGE), that's OK. A sample scenario project file has been provided for you. You may start the HMI prototype by typing `run_elviss sample.prj` at the command line and press <Enter>.

To exit the HMI Prototype, select the Exit button located in the bottom left-hand corner of the HMI Prototype window.

5.3 Using the ELVISS HMI Prototype in an Experiment

The ELVISS HMI Prototype has been enhanced to allow the execution of experimental scenarios and to collect data relevant to the empirical investigation of different sensor characteristics on search and detection capability under different simulated environmental conditions.

The experimental scenarios are based around a detection and discrimination task. The ELVISS operator is instructed to use the HMI Prototype to search the scenario landscape for target objects and to "designate" those target objects that are believed to be true-targets, while ignoring false-target objects. At the end of an experimental scenario, the ELVISS operator's performance is evaluated based on the accuracy of the detection/rejection of true-targets/false-targets and based upon the response time between target designations.

5.3.1 Tuning the Experiment

A number of runtime parameters may be adjusted to tune the way in which the prototype and data collection applications function. These parameters are modified through the use of UNIX environment variables. An environment variable is a means of storing data that is universally accessible to all applications that are executed in the operating environment. There are two environment variables that are of interest for tuning an experiment: `ELVISS_NUM_PROC` and `ELVISS_TGT_TOLERANCE`.

The `ELVISS_NUM_PROC` environment variable defines the number of processors available for use by the ELVISS Prototype software. By using multiple processors, the performance of the ELVISS Prototype can be significantly increased. However, this is only of benefit on a workstation that has more than one processor. If more than one processor is available, the ELVISS Prototype software can be configured to use one or two processors by setting `ELVISS_NUM_PROC` to '1' or '2', respectively. If `ELVISS_NUM_PROC` is not set, the prototype software will assume that only one processor is available.

The ELVISS_TGT_TOLERANCE environment variable allows the user to modify the tolerance employed by the experiment scoring mechanism to judge a subject object designation as a 'hit' or a 'miss'. The scoring mechanism creates a set of imaginary spheres with a radius equal to ELVISS_TGT_TOLERANCE and a centre equal to the position of each target object. If a designated point falls within the bounds of one of these imaginary spheres it is counted as a 'hit', otherwise it is considered a 'miss'. If ELVISS_TGT_TOLERANCE is not set, the prototype software will utilize a default value of ten (10.0) meters.

5.3.2 Adjusting Runtime Retro-Reflective Behaviour

The ELVISS HMI Prototype provides a very simple simulation of a retro-reflective surface. This simulation does not represent a physics based approximation of retro-reflectivity but provides an obvious visual cue to the operator that, when viewed at a distance, mimics the attention-grabbing characteristics of a retro-reflective object when illuminated by a laser source.

The simulation is achieved by using an object called a "light point". A light point is a simulated representation of a discrete light source and may be likened in appearance to a star in the night sky. A number of runtime behaviour characteristics have been exposed in order to provide some flexibility to the experimenter. These characteristics may be modified through the use of three (3) environment variables:

ELVISS_MIN_LIGHT_SIZE, ELVISS_MAX_LIGHT_SIZE and ELVISS_ACTUAL_LIGHT_SIZE.

ELVISS_MIN_LIGHT_SIZE defines the minimum number of pixels that the system will use to draw a light point as the viewpoint moves away from the light point position. The default value is 4.0 (pixels).

ELVISS_MAX_LIGHT_SIZE defines the maximum number of pixels that the system will use to draw a light point as the viewpoint approaches the light point position. The default value is 10.0 (pixels).

ELVISS_ACTUAL_LIGHT_SIZE defines the default number of pixels that the system will use to draw a light point as the viewpoint moves in the range not influenced by ELVISS_MIN_LIGHT_SIZE or ELVISS_MAX_LIGHT_SIZE. The default value for ELVISS_ACTUAL_LIGHT_SIZE is 1.0 (pixel).

6. File Specifications

6.1 General

The ELVISS Prototype System utilizes a number of files to store both scenario related information as well as experimental data. These two categories of files will be referred to as "Scenario Definition" files and "Data Collection" files. The specification for the content of these files is provided in the following sections.

6.2 Scenario Definition Files

The preferred method of creating Scenario Definition files is via the ELVISS SGE. However, there may be some occasion when you desire to generate/manipulate the content of the Scenario Definition files by hand.

The Scenario Definition files are ASCII "flat" files. This means that they may be edited with any text editor. The content of the Scenario Definition files is organized into *sections*. Each section contains a number of *parameters*. Groups of parameters are separated by a blank line. Sections are also separated by a blank line.

Section labels assist in the readability of the files and do not represent any real value to the Scenario Definition files. Section labels may be recognized insofar as the label is enclosed by square brackets (i.e. [General]).

Parameters specify the values that define various elements of the scenario. Parameters follow an assignment syntax (i.e. TotalTargets=8). No white space should be inserted either before or after the '=' sign.

The formats for line spacing and white space insertion are very strict. Careful attention should be paid to these formatting requirements if you wish to manually manipulate the Scenario Definition files.

6.2.1 Target Definition File

The Target Definition file contains information about the characteristics of targets for an experimental scenario. A Target Definition file is characterized by a ".tgt" file extension. The following table specifies the sections, parameters and valid parameter values for a Target Definition file.

Table 6. Target Definition File Specification

LABEL	DESCRIPTION	VALUE
[General]	General section label.	N/A
TotalTargets	The total number of targets defined in the following sections.	0 - 50

	following sections	
[Target_#]	Section label for Target_# where # represents an integer value (i.e. 1, 2, 3, etc.). This number will be '1' for the first target and will increment for each target up to a maximum value of <i>TotalTargets</i> .	1 - 50
IsTarget	A flag to indicate if this is a "true target" as opposed to a "false target"	0 = false target 1 = true target
Type	An integer value mapping to a 3D model type defined in the Target Mapping file (see Section 6.2.5).	See Section 6.2.5
Visibility	An integer value defining the visibility of the target with respect to the simulated AGTV and FLIR sensors.	0 = Both 1 = AGTV Only 2 = FLIR Only
Orientation	A single precision floating point value representing the orientation or heading of the target. An orientation of 0 represents North.	0.0 - 359.9
LocationX	A single precision floating point value representing the location of the target on the X axis.	Any valid single precision floating point value.
LocationY	A single precision floating point value representing the location of the target on the Y axis.	Any valid single precision floating point value.
LocationZ	A single precision floating point value representing the location of the target on the Z axis.	Any valid single precision floating point value.
HasLabel	A flag indicating if the target object should be enhanced with an identifier billboard.	0 = no label 1 = label
Label	An integer value mapping to an alpha-numeric character that may be display on an identifier billboard object.	0 - 9 = 0 - 9 10 - 16 = A - F
CirOverrideAGTV	A flag indicating if the AGTV target colour is being modified.	0 = colour not modified 1 = colour modified
CirAGTV	The value for the AGTV target colour.	0.0 - 1.0
CirOverrideFLIR	A flag indicating if the FLIR target colour is being modified.	0 = colour not modified 1 = colour modified
CirFLIR	The value for the FLIR target colour.	0.0 - 1.0
RetroReflective	A flag indicating if the target has retro-reflective properties	0 = target is not retro-reflective 1 = target is retro-reflective
Name	An alpha-numeric string used to identify the target in the SGE.	Any character string. Maximum length of 16 characters.

Following is an example of a Target Definition file:

```
[General]
TotalTargets=3

[Target_1]
IsTarget=1
Type=7
Visibility=0
Orientation=0.0
LocationX=2044.5020
LocationY=-2002.1516
LocationZ=51.0000
HasLabel=1
Label=0
ClrOverrideAGTV=0
ClrAGTV=0.5000
ClrOverrideFLIR=0
ClrFLIR=0.5000
RetroReflective=0
Name=T72

[Target_2]
IsTarget=0
Type=1
Visibility=0
Orientation=0.0
LocationX=86.1368
LocationY=-2189.9048
LocationZ=27.8673
HasLabel=1
Label=1
ClrOverrideAGTV=1
ClrAGTV=0.9000
ClrOverrideFLIR=1
ClrFLIR=0.2000
RetroReflective=1
Name=Truck
```

6.2.2 Flight Plan Definition File

The Flight Plan Definition file contains information about the waypoints and flight path to be followed by a simulated search aircraft. A Flight Plan Definition file is characterized by a ".fp" file extension. The following table specifies the sections, parameters and valid parameter values for a Flight Plan Definition file.

Table 9. Flight Plan Definition File Specification

LABEL	DESCRIPTION	VALUE
[General]	General section label.	N/A
TotalWaypoints	The total number of waypoints defined in the following sections.	0 - 50
Pattern	The flight pattern represented by the sequence of waypoints.	0 = User Defined 1 = Creeping Line Ahead 2 = Expanding Square
S	The separation between flight plan legs (measured in kilometres).	0.1 - 10.0
NumLegs	The number of legs that make up the flight plan.	1 - 20
LegLength	The length of the individual legs (in the case of Creeping Line Ahead). Measured in kilometres.	0.1 - 100.0
Direction	The direction of the first turn (in the case of Expanding Square).	0 = Clockwise 1 = Counter-Clockwise
[Waypoint_#]	Section label for Waypoint_# where # represents an integer value (i.e. 1, 2, 3, etc.). This number will be '1' for the first waypoint and will increment for each waypoint up to a maximum value of TotalWaypoints.	1 - 50
LocationX	A single precision floating point value representing the location of the waypoint on the X axis.	Any valid single precision floating point value.
LocationY	A single precision floating point value representing the location of the waypoint on the Y axis.	Any valid single precision floating point value.
LocationZ	A single precision floating point value representing the location of the waypoint on the Z axis.	Any valid single precision floating point value.
Speed	An integer value representing the speed of the simulated search aircraft at that waypoint. Measured in knots.	1 - 200

Following is an example of a Flight Plan Definition file:

```
[General]
TotalWaypoints=3
Pattern=2
S=1.1
NumLegs=13
LegLength=10.0
Direction=0

[Waypoint_1]
LocationX=516.1219
LocationY=293.7071
LocationZ=350.0000
Speed=100.0

[Waypoint_2]
LocationX=-583.8781
LocationY=293.7071
LocationZ=350.0000
Speed=100.0

[Waypoint_3]
LocationX=-583.8781
LocationY=1393.7071
LocationZ=350.0000
Speed=100.0
```

6.2.3 Configuration File

The Configuration file contains information about the Scenario Landscape, the configuration of the simulated sensors and the configuration of the HMI Prototype. A Configuration file is characterized by a ".cfg" file extension. The following table specifies the sections, parameters and valid parameter values for a Configuration file.

Table 10. Configuration File Specification

LABEL	DESCRIPTION	VALUE
[Terrain]	Terrain section label.	N/A

TerrainFile	The absolute file path to the terrain database file.	A valid IRIX file path.
Environment		
[Environment]	Environment section label.	N/A
TOD	The Time of Day (TOD) to be represented in the HMI Prototype.	0.0 - 23.9
Wx	The weather condition to be represented in the HMI Prototype.	0 = Clear 1 = Foggy
WxRange	The range to total obscuration by fog to be represented in the HMI Prototype. Measured in meters.	1.0 - 10000.0
AGTV_Effect	The capability of the simulated AGTV sensor to penetrate the fog.	1 - 5
FLIR_Effect	The capability of the simulated FLIR sensor to penetrate the fog.	1 - 5
Sensors		
[Sensors]	Sensors section label.	N/A
WindowCfg	An integer value that controls the layout of the sensor video presentation in the HMI Prototype.	0 = Both Equal 1 = AGTV Primary 2 = FLIR Primary 3 = AGTV Only 4 = FLIR Only
Slaved	A flag that, when set, "Slaves" the FLIR sensor FOV to that defined for the AGTV.	0 = not slaved 1 = slaved
AGTV_FOV_Min	A single precision floating point value that assigns the minimum allowable AGTV FOV that may be achieved in the HMI Prototype. Measured in degrees.	0.5 - 40.0
AGTV_FOV_Max	A single precision floating point value that assigns the maximum allowable AGTV FOV that may be achieved in the HMI Prototype. Measured in degrees.	0.5 - 40.0
AGTV_Mode	An integer value that controls the zoom control for the AGTV.	0 = Continuous 1 = Discrete
AGTV_BeamWidth	An integer value that defines the default width of the illuminator beam.	0 = Wide 1 = Narrow
AGTV_SimCCD	An integer value that defines the state of CCD simulation.	0 = Do not simulate CCD 1 = Simulate CCD
AGTV_NarrowSize	An integer value that defines the size (in degrees) of the AGTV laser illuminator beam when operating in "Narrow" FOV mode.	0 = 2° 1 = 5°

AGTV_WideSize	An integer value that defines the size (in degrees) of the AGTV laser illuminator beam when operating in "Wide" FOV mode.	0 = 10° 1 = 15° 2 = 20°
FLIR_FOV_Min	A single precision floating point value that assigns the minimum allowable FLIR FOV that may be achieved in the HMI Prototype. Measured in degrees.	0.5 – 40.0
FLIR_FOV_Max	A single precision floating point value that assigns the maximum allowable FLIR FOV that may be achieved in the HMI Prototype. Measured in degrees.	0.5 – 40.0
FLIR_Mode	An integer value that controls the zoom control for the FLIR.	0 = Continuous 1 = Discrete
[Misc]		
[Misc]	Miscellaneous section label.	N/A
MapScale	An integer value that controls the default map scale setting.	0 = 1:50,000 1 = 1:250,000
MapOrient	An integer value that controls the default map orientation setting.	0 = North Up 1 = Aircraft Up 2 = Sensor Up
MapSymbol	An integer value that controls the default aircraft symbol setting.	0 = Icon 1 1 = Icon 2 2 = Icon 3
ScanRate	An integer value that controls the default scan rate setting.	0 = 1.5 deg/s 1 = 3.0 deg/s 2 = 4.5 deg/s
ScanWidth	An integer value that controls the default scan sweep width setting.	0 = 30 deg 1 = 60 deg 2 = 90 deg
ScanEnable	An integer value that controls the default scan state setting.	0 = scan disabled 1 = scan enabled
JoyMode	An integer value that controls the default joystick mode setting.	0 = aircraft mode 1 = cursor mode
ZoomMode	An integer value that controls the default zoom mode setting.	0 = Forward-Zoom In 1 = Forward-Zoom Out

Following is an example of a Configuration file¹:

¹ Although the example shows the wrapping of data from one line to the next, this is a limitation of Microsoft Word and should not occur in the Configuration file.

```

[Terrain]
TerrainFile=/usr/people/elviss/ELVISS/data/DB/certain_imp
act/models/terrain.pfb

[Environment]
TOD=12.0
Wx=1
WxRange=5000.0
AGTV_Effect=1.0
FLIR_Effect=2.0

[Sensors]
WindowCfg=0
Slaved=0
AGTV_FOV_Min=5.0
AGTV_FOV_Max=20.0
AGTV_Mode=0
AGTV_BeamWidth=0
AGTV_SimCCD=0
AGTV_NarrowSize=1
AGTV_WideSize=1
FLIR_FOV_Min=2.5
FLIR_FOV_Max=38.0
FLIR_Mode=1

[Misc]
MapScale=1
MapOrient=0
MapSymbol=1
ScanRate=2
ScanWidth=0
ScanEnable=0
JoyMode=0
ZoomMode=1

```

6.2.4 Project Definition File

The Project Definition file contains references to a Target Definition file, a Flight Plan Definition file and a Configuration file. A Project Definition file is characterized by a ".prj" file extension. The following table specifies the sections, parameters and valid parameter values for a Project Definition file.

Table 11. Project Definition File Specification

LABEL	DESCRIPTION	VALUE
[General]	General section label.	N/A

ConfigFile	The absolute file path to a Configuration file.	A valid IRIX file path.
TargetFile	The absolute file path to a Target Definition file.	A valid IRIX file path.
FlightPlanFile	The absolute file path to a Flight Plan Definition file.	A valid IRIX file path.

Following is an example of a Project Definition file²:

```
[General]
ConfigFile=/usr/people/mgamble/Projects/ELVISS/data/scenarios/certain.cfg
TargetFile=/usr/people/mgamble/Projects/ELVISS/data/scenarios/certain.tgt
FlightPlanFile=/usr/people/mgamble/Projects/ELVISS/data/scenarios/certain_exp.fp
```

6.2.5 Target Mapping File

The Target Mapping file relates a "descriptive" name to a 3D model file name. This approach was used in order to provide a meaningful name to the SGE user, while maintaining the capability to represent an appropriate 3D model in the HMI Prototype.

The Target Mapping file contains two columns of alpha-numeric data. The first column contains the descriptive name of the object, while the second column contains the file name of the 3D model.

The contents of the Target Mapping file are read at runtime by both the SGE and the HMI Prototype. As such, you may add additional targets to the Target Mapping file by following the simple two-column format. The target *Type* field present in the Target Definition file utilizes a numerical index into the Target Mapping file. For this reason it is recommended that any new entries be appended to the *end* of the file so as not to invalidate any scenarios that were developed prior to your modifications.

6.3 Data Collection Files

The HMI Prototype collects three categories of data: discrete user inputs, target designation and streaming scenario data. These categories of data provide a complete

² Although the example shows the wrapping of data from one line to the next, this is a limitation of Microsoft Word and should not occur in the Project Definition file.

picture of the operator events that occurred during the execution of a scenario, as well as the status of the simulated aircraft and sensor package with respect to scenario time. The HMI Prototype also creates a fourth data file that contains a summary of the experimental results (scoring, etc.).

Each type of data is stored in a separate output file:

- A control file (.ctl) contains information about what discrete prototype controls were manipulated and at what time the manipulation took place.
- A mark file (.mrk) contains information about discrete operator designations and the time at which the designation took place.
- A stream file (.strm) contains information about the position and orientation of the simulated search aircraft and sensor package, collected at a pre-defined sampling rate.
- A results file (.rslt) contains summary information about the outcome of the experiment.

The data files are created and stored in \$ELVISS_HOME/data/exp.

6.3.1 File Naming Convention

A file naming convention was developed for the naming of the data collection files in order to allow for easy recognition and sorting of files post-experiment. The data collection files are named as follows:

`<scenario_name>_<subject_number>_<trial_number>.<ext>`

Where:

`<scenario_name>` corresponds to the name of the .prj file provided to the HMI Prototype as a command line parameter at startup.

`<subject_number>` refers to the subject number provided to the HMI Prototype as a command line parameter at startup.

`<trial_number>` refers to the trial number provided to the HMI Prototype as a command line parameter at startup.

`<ext>` is the file extension that corresponds to the various categories of collected data (i.e. .mrk, .ctl, .strm and rslt).

For example, if the command used to start the HMI Prototype was:

```
run_elviss sample.prj 1 2
```

The resulting data collection files would be named:

sample_1_2.mrk
 sample_1_2.ctl
 sample_1_2.strm
 sample_1_2.rslt

6.3.2 The Control Data File

The control data file contains time-stamped information about the discrete operator control events that occurred during the execution of an experimental scenario. The control data file contains two columns of data. The significance of these columns is explained in Table 12.

Table 12. Control Data File Contents

COLUMN	DESCRIPTION	RANGE/UNITS
1	The time in the experiment at which the discrete control event occurred.	Range: 0.0000 - 7 Units: seconds
2	A numeric code representing the event that occurred.	Refer to the Event List located in Appendix B.

6.3.3 The Mark Data File

The mark data file contains time-stamped information about the target designations made by the operator during the execution of an experimental scenario. By comparing the designated coordinates with the target locations, an assessment of the operator accuracy and response time may be made. The mark data file contains four columns of data. The significance of each column is explained in Table 13.

Table 13. Mark Data File Contents

COLUMN	DESCRIPTION	RANGE/UNITS
1	The time in the experiment at which the designation event occurred.	Range: 0.0000 - 7 Units: seconds
2	The designated X coordinate on the scenario landscape.	Range: Any valid floating point value Units: Meters
3	The designated Y coordinate on the scenario landscape.	Range: Any valid floating point value Units: Meters
4	The designated Z coordinate on the scenario landscape.	Range: Any valid floating point value Units: Meters

6.3.4 The Stream Data File

The stream data file contains time-stamped information about the position and orientation of the simulated aircraft and sensor package during the execution of the experimental scenario. This information is collected on a

continuous basis at a pre-defined sampling rate. A default sampling rate of 10 Hz is used, although the user may change this rate by setting the ELVISS_DC_RATE environment variable to a number between 1 and 50 prior to starting the ELVISS HMI Prototype. The stream data file contains fifteen columns of data. The significance of each column is explained in Table 14.

Table 14. Stream Data File Contents

COLUMN	DESCRIPTION	RANGE/UNITS
1	The time in the experiment at which the designation event occurred.	Range: 0.0000 to ? Units: seconds
2	The X coordinate of the simulated search aircraft.	Range: Any valid floating point value Units: Meters
3	The Y coordinate of the simulated search aircraft.	Range: Any valid floating point value Units: Meters
4	The Z coordinate of the simulated search aircraft.	Range: Any valid floating point value Units: Meters
5	The heading of the simulated search aircraft.	Range: 0.0 to 359.0 Units: Degrees
6	The pitch of the simulated search aircraft.	Range: -180.0 to +180.0 Units: Degrees
7	The roll of the simulated search aircraft.	Range: -180.0 to +180.0 Units: Degrees
8	The X coordinate on the scenario landscape being intersected by the sensor ball "look" vector.	Range: Any valid floating point value Units: Meters
9	The Y coordinate on the scenario landscape being intersected by the sensor ball "look" vector.	Range: Any valid floating point value Units: Meters
10	The Z coordinate on the scenario landscape being intersected by the sensor ball "look" vector.	Range: Any valid floating point value Units: Meters
11	The heading of the sensor ball.	Range: 0.0 to 359.0 Units: Degrees
12	The pitch of the sensor ball.	Range: -180.0 to +180.0 Units: Degrees
13	The roll of the sensor ball.	Range: -180.0 to +180.0 Units: Degrees
14	The field of view of the simulated AGTV sensor	Range: 0.5 to 40.0 Units: Degrees
15	The field of view of the simulated FLIR sensor	Range: 0.5 to 40.0 Units: Degrees

6.3.5 The Result Data File

The result data file contains a summary of the experimental outcome including scoring information and an overview of the recorded target designations. The results data file contains three sections of data. The significance of each section of data is explained in Table 15.

Table 15. Result Data File Contents

SECTION	DESCRIPTION	RANGE/UNITS
1	A scoring summary for the experiment trial. The scoring output comprises three lines of data formatted as follows: Correctly detected targets = <result> Incorrectly detected targets = <result> Missed targets = <result>	N/A
2	A designation summary for the experiment trial. The designation summary comprises a continuous line of tab delimited data parameters formatted in the following repeated pattern: <time of designation> <target name> <correct/incorrect>	<time of designation> Range: 0.0000 to 7 Units: seconds <target name> Range: N/A Units: N/A <correct/incorrect> Range: 0 (incorrect) – 1 (correct) Units: N/A

Annex A – Target Object Types

Included with the delivery of the ELVISS Prototype System is a library of target object models. These models may be used as targets/non-targets for the creation and execution of experimental scenarios. The following table provides the names of the target objects and a description of each object model.

Table 16. Target Object Types

NAME	DESCRIPTION
Truck_Desert	Military truck with desert paint scheme
Truck_OD	Military truck with olive drab paint scheme
Hummer_Desert	Military jeep with desert paint scheme
Hummer_OD	Military jeep with olive drab paint scheme
Leclerc_Tank_Desert	LeClerc (French) tank with desert paint scheme
Leclerc_Tank_Camo	LeClerc (French) tank with camouflage paint scheme
Leclerc_Tank_OD	LeClerc (French) tank with olive drab paint scheme
T72_Tank_Desert	T72 (Russian) tank with desert paint scheme
T72_Tank_OD	T72 (Russian) tank with olive drab paint scheme
OH58_Helicopter	OH58 Kiowa reconnaissance helicopter
AH64D_Helicopter	AH64D Longbow apache attack helicopter
A10_Fighter	A10 Warthog Anti-Tank Aircraft
Pyramid_1M	Un-textured 1 meter high pyramid
Pyramid_2M	Un-textured 2 meter high pyramid
Pyramid_3M	Un-textured 3 meter high pyramid
Diamond_1M	Un-textured 1 meter high diamond
Diamond_2M	Un-textured 2 meter high diamond
Diamond_3M	Un-textured 3 meter high diamond
Cube_1M	Un-textured 1 meter high cube
Cube_2M	Un-textured 2 meter high cube
Cube_3M	Un-textured 3 meter high cube

Cylinder_1M	Un-textured 1 meter high cylinder
Cylinder_2M	Un-textured 2 meter high cylinder
Cylinder_3M	Un-textured 3 meter high cylinder
Pyramid_1M_TEX	Textured 1 meter high pyramid
Pyramid_2M_TEX	Textured 2 meter high pyramid
Pyramid_3M_TEX	Textured 2 meter high pyramid
Diamond_1_TEX	Textured 1 meter high diamond
Diamond_2M_TEX	Textured 2 meter high diamond
Diamond_3M_TEX	Textured 3 meter high diamond
Cube_1M_TEX	Textured 1 meter high cube
Cube_2M_TEX	Textured 2 meter high cube
Cube_3M_TEX	Textured 3 meter high cube
Cylinder_1M_TEX	Textured 1 meter high cylinder
Cylinder_2M_TEX	Textured 2 meter high cylinder
Cylinder_3M_TEX	Textured 3 meter high cylinder
Murray	"Murray" person figure
Homer	"Homer Simpson" person figure

Annex B – HMI Event List

The control data file, one of three output files from the HMI data collection process, uses a set of numerical values to represent the various operator originated discrete control events that may occur during the execution of an experimental scenario. The following table provides a mapping from the numerical value stored in the control data file to the HMI control event.

Table 17. HMI Event List

VALUE	EVENT
0	HMI_SCEN_START
1	HMI_SCEN_STOP
2	HMI_SLEW
3	HMI_DESIGNATE
4	HMI_AUTO_TRACK_ON
5	HMI_AUTO_TRACK_OFF
6	HMI_MENU_UP
7	HMI_MENU_DOWN
8	HMI_MENU_LEFT
9	HMI_MENU_RIGHT
10	HMI_MENU_PLUS
11	HMI_MENU_MIN
12	HMI_MENU_RTN
13	HMI_STATUS_ON
14	HMI_STATUS_OFF
15	HMI_PRIM_AGTV
16	HMI_PRIM_FLIR
17	HMI_FLIR_WIDE
18	HMI_FLIR_NARROW
19	HMI_AGTV_2X

20	HMI_AGTV_IX
21	HMI_RNG_AUTO
22	HMI_RNG_MAN
23	HMI_RNG_GATE_CONT
24	HMI_RNG_GATE_GATED
25	HMI_HIDE_PIC
26	HMI_SHOW_PIC
27	HMI_GYRO_ON
28	HMI_GYRO_OFF
29	HMI_GYRO_RAPID_ERECT
30	HMI_ILLUMINATOR_ARMED
31	HMI_ILLUMINATOR_SAFE
32	HMI_EMERG_STOP_ACTIVATED
33	HMI_EMERG_STOP_DEACTIVATED
34	HMI_RF_ARMED
35	HMI_RF_SAFE
36	HMI_RF_CONT
37	HMI_RF_MAN
38	HMI_RF_RNG
39	HMI_RF_LAST
40	HMI_RF_NTL
41	HMI_RF_FIRST
42	HMI_M_HIST_CLEAR
43	HMI_M_HIST_SHOW
44	HMI_M_HIST_HIDE
45	HMI_M_HIST_EO
46	HMI_M_HIST_AC

47	HMI_M_SCALE_1_250
48	HMI_M_SCALE_1_50
49	HMI_M_SCALE_1_10
50	HMI_SCAN_SCAN
51	HMI_SCAN_RATE_1_5
52	HMI_SCAN_RATE_3_0
53	HMI_SCAN_RATE_4_5
54	HMI_SCAN_SIZE_30
55	HMI_SCAN_SIZE_60
56	HMI_SCAN_SIZE_90
57	HMI_CLR_FREEZE_FRM
58	HMI_CONTACT_1
59	HMI_CONTACT_2
60	HMI_CONTACT_3
61	HMI_CONTACT_4
62	HMI_CONTACT_5
63	HMI_CONTACT_6
64	HMI_MMAP_LOCATOR
65	HMI_MMAP_NORTH_UP
66	HMI_MMAP_AC_UP
67	HMI_MMAP_CAM_UP
68	HMI_ICON_1
69	HMI_ICON_2
70	HMI_ICON_3
71	HMI_EO_EVEN
72	HMI_EO_UNEVEN
73	HMI_JOY_MODE_AC

74	HMI_JOY_MODE_CURSOR
75	HMI_ILLUM_WIDE
76	HMI_ILLUM_NARROW
77	HMI_IR_WHITE_HOT
78	HMI_IR_BLACK_HOT

Annex C – ELVISS Environment Variables

The ELVISS Prototype software utilizes a number of environment variables to control configuration and execution parameters. The following table defines the environment variables that affect the ELVISS Prototype System.

Table 18. ELVISS Environment Variables

VARIABLE	DESCRIPTION
ELVISS_DATA	Defines the location of the directory where ELVISS data files are stored. Data files include terrain databases, target models, scenario definitions and experimental data. This environment variable is generated automatically by scripts in the \$ELVISS_HOME/bin directory and should not be set by the user.
ELVISS_HOME	Defines the 'home' directory for the ELVISS software installation. This directory is created during the installation process. The ELVISS_HOME environment variable should be defined in the users' .cshrc file. Refer to Section 2.4 – Environment Variables.
ELVISS_NUM_PROC	Defines the number of processors available for use by the ELVISS Prototype software. This environment variable should be set to '1' on machines with one processor, and '2' on machines with two or more processors. If not defined, the value is assumed to be 1.
ELVISS_TGT_TOLERANCE	Defines the tolerance (in meters) to be used by data collection calculations in determining a successful/unsuccessful designation. If the designated position is within the bounds of an imaginary sphere of radius equal to ELVISS_TGT_TOLERANCE, it is counted as a 'hit' otherwise it is counted as a 'miss'. If not defined, a default tolerance of 10.0 meters will be used.
ELVISS_MIN_LIGHT_SIZE	Defines the minimum retro reflective light size in pixels. The default value is 4.0 pixels. If ELVISS_MIN_LIGHT_SIZE is greater than ELVISS_MAX_LIGHT_SIZE then the default values are used. Value must be a positive floating-point number.
ELVISS_MAX_LIGHT_SIZE	Defines the maximum retro reflective light size in pixels. The default value is 10.0 pixels. If ELVISS_MIN_LIGHT_SIZE is greater than ELVISS_MAX_LIGHT_SIZE then the default values are used. Value must be a positive floating-point number.
ELVISS_ACTUAL_LIGHT_SIZE	Defines the actual retro reflective light size in meters. The default value is 1.0 meter. This value is the size the light appears when not being overridden by ELVISS_MIN_LIGHT_SIZE or ELVISS_MAX_LIGHT_SIZE. Value must be a positive floating-point number.

Bibliography

Gamble, Murray G. (November 10, 2000). Proposal to Modify ELVISS Prototype Software. Volume One - Technical and Management Proposal. The HFE Group.

Neal, B. (April 28, 1999). ELVISS Human Engineering Design Approach Document - Operator. Canadian Marconi Company.

Neider, Jackie. (1993). *OpenGL Programming Guide*. Addison Wesley.

List of symbols/abbreviations/acronyms/initialisms

AGTV	Active Gated TV
ALBEDOS	Airborne Laser-Based Enhanced Detection and Observation System
ASCII	American Standard Code for Information Interchange
DND	Department of National Defence
DREV	Defence Research Establishment Valcartier
ELVISS	Enhanced Low-Light Level Visible and Infrared Surveillance System
FLIR	Forward Looking Infrared
FLTK	Fast Light Tool Kit
FOV	Field of View
HMI	Human Machine Interface
IR	Infrared
MMD	Moving Map Display
N/A	Not Applicable
PC	Personal Computer
SAR	Search and Rescue
SGE	Scenario Generation Environment
SGI	Silicon Graphics, Inc.
TOD	Time of Day
VAPS	Virtual Applications Prototyping System
VPI	Virtual Prototypes, Inc.
Wx	Weather

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14 ABSTRACT

(U) The HFE Group has performed development for, and modifications to, a software prototype of the Enhanced Low-Light Level Visible and Infrared Surveillance System (ELVISS) user interface. The intent of this work was to enhance the capability of the ELVISS software to allow the empirical investigation of different interface and sensor characteristics on search and detection capability under different simulated environmental conditions.

The execution of this work required the use of several software tools on Silicon Graphics, Inc. (SGI) and personal computer (PC) platforms. The prototype was developed using Virtual Prototypes, Inc. (VPI) VAPS software and SGI OpenGL Performer software. In addition to the modification of the prototype, a scenario generation interface was developed using SGI OpenGL Performer software and the public domain Fast Light Tool Kit (FLTK).

15 KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) sensor surveillance system, interface design